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## BROADCASTING AND TELEVISION: MONOPOLY OR COMPETITION?

THE stimulating address on some problems of communication which Barbara Wootton delivered to the Aslib Conference at Nottingham last autumn was essentially a plea for the use of the right tool for the right purpose. Its analysis of the way in which channels of communication may be blocked, and particularly of the difficulty in the way of communicating exact or quantitative knowledge, has a profound bearing on the current discussion of the future of television and even of broadcasting itself. Prof. Wootton could point to some striking illustrations of the inefficiency of broadcast talks, and even of the limitations of written communication where mathematical precision or quantitative expression is demanded; she thinks it is doubtful whether the average citizen understands more than about a quarter of such a broadcast talk as those given in the series "Topic for To-night", and that quarter may well be a random collection of the ideas presented to him, in which subsidiary points may figure unduly.

The limitations are set, not so much by the imperfections in the technique of the broadcaster, as by the intelligence of the listener, and, as Prof. Wootton well indicates, this position plays into the hand of the emotional broadcaster, even where precision is essential in order to afford a sound judgment. Nor will the difficulty be resolved merely by drawing a sharper line between objectively established fact and subjective speculation, important as is that distinction. Seen from the point of view of adult education, the imaginative art must be enlisted to secure from the listener or reader or viewer the educational effort and the mental co-operation which are indispensable to a clearer understanding of questions of fact whether in social science, in public affairs or in any other field of human knowledge and endeavour.

In this position lies the real danger which may arise when broadcasting and television are regarded on any other level than that of a public service. Because neither broadcasting nor television in itself demands more active co-operation from listener or viewer than the turning of a knob, they can all too easily encourage the passive receptivity that offers the great danger to standards of public taste. Now that the Television Bill has been published, it is important to consider carefully the issues that are raised.

"Television", as the Government's White Paper, quoting from the report of the Beveridge Committee, admits, "has great and increasing power in influencing men's minds"; but that power, unless exercised responsibly and imaginatively, confirms men in their passivity and prejudices rather than uplifts and enlightens them. Evidence enough of this tendency was quoted in the parliamentary debates nearly four months ago on the Government's proposals and in Lord Simon's recent book "The B.B.C. from Within"*, and the educational aspect of these two media of

* The B.B.C. from Within. By Lord Simon. Pp. 360. (London: Victor Gollancz, 1953.) 16*s.* net.

communication is of such vital importance that it overshadows completely the question of monopoly.

On this point there are two passages in Lord Simon's book which should be noted. In cultural matters, he points out, the B.B.C. has great influence; it does consciously seek—and often with outstanding success—to raise standards and to create new tastes. In politics and in religion, however, it is entirely neutral; its broadcasts are proportional to the demands of organized public opinion and it has no power and shows no initiative, except in freely encouraging to the very best of its ability the broadcasting of information, opinion and discussion by leaders of thought in all religious and political fields. Lord Simon dismisses as unfounded the idea that the B.B.C. is dangerously powerful. Its influence is great and its practice and policy sufficiently diversified to secure reasonable freedom on the air, if not sufficiently so to satisfy all minorities. He regards its influence on the whole as promoting, through its news, talks, discussions and features, an informed and responsible British democracy, more tolerant and wiser than many others.

That much lies to the credit of the public service ideal, though even here the danger is not excluded that broadcasting as well as television, if too much time is given to it, may prove inimical to the formation of independent-thinking citizens of democracy. That danger is bound to be greater if either passes under the influence or control of commercial interests, whose concern with public service is a secondary matter, and whose dependence upon advertising for revenue renders sales promotion a dominant motive. Such a self-denying ordinance as the exclusion of sensational television between the hours of six and eight in the evening is too much to expect in these conditions. Commercial television or broadcasting might conceivably assist the introduction of a higher standard of political commentator. The failure of the B.B.C. to use regular political commentators and so to build up their influence is cited by Lord Simon as evidence of the B.B.C.'s impotence to influence opinion in public affairs in any given direction. Commercial television or broadcasting might remedy this defect of monopoly and facilitate the introduction of commentators of the standard of the best of American commentators. It could equally open the door to the more sensational and irresponsible, and this disadvantage of monopoly may well be corrected more widely by some other means such as the alternative public service concerns, towards which Lord Simon himself leans.

Hitherto, in Great Britain, the existence of monopoly has been consistent with the responsible exercise of influence rather than power in broadcasting. The British Broadcasting Corporation has discharged its trust in a way which has won almost universal tribute. Nevertheless, the debate on monopoly was opened rather than closed by the report of the Beveridge Committee, and the alternatives to the present system are the subject of objective, as well as subjective, inquiry and discussion. Concern, moreover, at the effects of broadcasting and television on society has sharpened anxiety about the possible consequences of their influence being exerted by any bodies other than those whose first responsibility is to provide a public service. In television and in broadcasting we have techniques which, wisely used, could, as Lord Simon's book indicates, be educational instruments of untold benefit to mankind. To them indeed apply the words with which H. A. L. Fisher, in 1935, closed the third volume of his "A History of Europe": "The developing miracle of science is at our disposal to use or abuse, to make or to mar. With science we may lay civilization in ruins or enter into a period of plenty and well-being the like of which has never been experienced by mankind". When Fisher wrote that, an insane racialism threatened, as he put it, to rupture the seamless garment of civilization. The rents have not yet been closed nor the wounds healed, and this question of television and broadcasting underlines his plea that we should replace our squandered treasures of humanity, toleration and good sense.

It is therefore not surprising that the vice-chancellors of thirteen universities of Britain should have recorded their conviction in a letter to *The Times* that to place television on a commercial basis, which must mean that the programme is determined by the criterion not of merit but of popularity, would be to throw away an instrument with very great possibilities for good. Informed opinions differ as to how much positive harm is done to the young by commercial television in other countries; but, as the vice-chancellors rightly point out, we have recently recognized in the television of the Queen's coronation the power of television for good, and if we deliberately discard that power we can never hope to recover it, and in this view the vice-chancellors have received strong support from other educational associations. The National Union of Teachers, the Workers' Educational Association and the Association of Education Committees, for example, have all made written representations on commercial television to the Minister of Education.

The debate which took place in the House of Lords on November 25 and 26 gave further indication that many thoughtful people are unalterably of the opinion that to commercialize television would mean both a danger, especially to the young, and a loss of great opportunities for good. That expression of opinion was virtually ignored by Government spokesmen in the Parliamentary debates, and on December 14, in a further letter to *The Times*, the vice-chancellors, while welcoming the Government's pledge against direct sponsoring, urged that the power of television was enormous and that any system which would permit commercial considerations to exercise a determining influence on programmes was most unwise. It would, in fact, have been a dereliction of duty if, as responsible leaders in education, they had not reaffirmed their strong and continuing belief that such a risk should be avoided.

An impressive feature of the report of the Beveridge Committee was that, in spite of an unconcealed distrust of monopoly, the Committee, with one dissentient,

recommended the continuance of the monopoly of the British Broadcasting Corporation as the lesser of two evils. It is now clearer than two years ago that the debate on monopoly has only begun: it is equally clear that, among those who are most alive to all that is involved, there is as yet no general agreement as to the wisest alternative to monopoly—in broadcasting or in television. For this reason the Archbishop of Canterbury's appeal to the Government that it should recognize that its proposals are by no means the only ones, that there may be better alternatives, that the real object should be an agreed solution which will satisfy the great majority of the nation, and that until that search has been made and failed the party machine should not be invoked, found strong support not only in the debate from Lord Beveridge himself, Lord Layton, Lord Waverley and others, but also outside the House. Thus the statement by the Assistant Postmaster-General, Mr. L. D. Gammans, that in preparing legislation the Government would consider carefully and sympathetically any alternative practicable proposals for terminating the B.B.C. monopoly, and the declared objective of the policy indicated in the White Paper on Television Policy "to proceed with caution into this field and to safeguard this medium of information and entertainment from the risk of abuse or lowering of standards", were welcomed.

Nevertheless, there is justification for the belief that the Government has given way to commercial interests and jeopardized the whole future of broadcasting and television in Great Britain. Nothing that was said in the Parliamentary debates by Government spokesmen touched this issue: the argument was never met. Moreover, doubts as to Government intentions and good faith were fanned by another omission. The second objective of television policy was defined in the White Paper as "to reduce to a minimum the financial commitments of the State". The previous White Paper on Broadcasting stated that "in the expanding field of television provision should be made to permit some element of competition when the calls on capital resources at present needed for purposes of greater national importance should make this feasible". On the question as to how far the diversion of resources to the expansion of television is at present justified, the White Paper on Television Policy and Government spokesmen in Parliament were silent. Taken with the Government's implied intention to continue to deduct part of the British Broadcasting Corporation's licence income, the Government's attitude on the financial and materials aspect of television is thoroughly unrealistic. The grave doubts and reservations on these points expressed by the Archbishop of Canterbury and Lord Waverley were completely ignored.

The Archbishop of Canterbury, referring to these passages in the two White Papers, asked how far it is wise at this time to put much more of our national financial and other resources into intensifying the output and accelerating the development of television. It seemed to be taken for granted by Government spokesmen, as well as by others, that the purposes of greater national importance are so well supplied with capital resources that those resources can now be diverted to the lesser purpose of competitive television. That is not a view which is likely to be shared by those who are concerned with the country's effort in scientific and technical research, and the calls which the development of atomic energy is already making on resources. In materials, as well as in trained man-power, the expansion of television is likely to compete for resources which are already failing to meet the full requirements of the Department of Scientific and Industrial Research, the universities, and industry. So far as buildings and equipment are concerned, the condemnation of the policy of both political parties in regard to schools and technical education contained in two recent reports from the Select Committee on Estimates makes nonsense of any proposals for the expansion of television until the glaring defects revealed in these two reports are in the way of being removed by appropriate allotment of the necessary resources of capital and materials, while road development might also reasonably be expected to have a prior claim.

Lord Waverley said little on this particular point; but his comment that there is at least a danger that more and more entertainment in the present circumstances may mean less and less effort left no doubt as to his misgivings. Certainly neither the Chancellor of the Exchequer nor his predecessor in that office, Mr. Hugh Gaitskell, had encouraged the belief that we can yet afford to divert national resources into the production or development of luxuries, such as is television on any serious and responsible view. Prudent consideration of available resources suggests the impartial exploration on non-party lines of the possibilities of terminating monopoly and securing the real advantages of competitive television without the dangers that dependence on revenue from advertising appears to involve.

This position gives further force to some comments of the Archbishop of Canterbury and others on the question of the licence fee for television. The Archbishop's suggestion that the licence fee should be raised as necessary to enable the B.B.C. alone to do its job well or to permit an element of competitive programmes, found support from all sides, even from those who are also prepared to experiment with advertising; and Lord Salisbury's rejection of such a suggestion ignored the Archbishop's sound comment that the licence fee should be such that people paid for what they got and did without amenities for which they could not pay. Nor did Lord Salisbury meet the point that if advertisements were introduced the revenue obtained from them should be used for subsidizing the whole service and thus avoid prejudicing hopelessly the position of the B.B.C., or the argument advanced by Lord Merthyr, Lord Moyne and others that the Government should drop its present practice of taking 15 per cent of the B.B.C.'s licence revenue. It is undoubtedly sound that, as Lord Beveridge remarked in supporting the Archbishop of Canterbury, people should pay directly rather than indirectly for their broadcasting or television.

In the early stages of the discussion, Mr. Selwyn Lloyd rejected any compromise except on the condition that an alternative system should draw some revenue from advertisements, but other spokesmen for the Government were not so unreasonable. Early in the House of Lords debate, the Postmaster-General, Earl de la Warr, had indicated the Government's readiness to consider Parliament's views before definite and detailed legislation was prepared, and even in Lord Salisbury's rather hard speech, he said that, within the broad basic principles of the Government's scheme, the Government was prepared to consider any suggestions that might be made. Lord Salisbury referred particularly to the ideas put forward by the Archbishop of Canterbury and by Lord Waverley as worthy of further study, which notably went far outside the conditions afterwards laid down by Mr. Selwyn Lloyd in the House of Commons debate.

Lord Waverley's remarks in particular deserve to be noted. He believes that no one can at present form a true estimate of the ultimate impact of television upon our economic, social and cultural life. In urging that we should wait before making the surrender involved in the Government's plan—a surrender which he is convinced would lead to a lowering of standards—he asked the Government, while accepting the principle of competition and agreeing reluctantly to the establishment of another public corporation, to look again at the finance and other features of its scheme with the view of eliminating dependence upon advertisements. Sir David Maxwell Fyffe's speech in concluding the debate in the House of Commons on December 15 was pre-eminently reasonable, and seems to hold open again the door which Mr. Lloyd had slammed. Sir David's remark, in connexion with monopoly, that the ultimate safeguard of liberty lies in diversity has implications which augur better for second thoughts by the Government on matters on which the spokesmen in Parliament were silent than might be judged from the general trend of the debates.

How important television is likely to become in moulding the civilization of the future cannot yet be judged, nor is a sound judgment likely to be formed in an atmosphere inflamed by party politics or heated argument over monopoly. There is need for much clearer thinking about the responsible exercise of power in a field relatively new and almost uncharted. Even the specific applications of television in education and the techniques demanded are still a matter for experiment, and there is indeed need that, as Lord Layton urged, as far as possible, our ventures into this new field should be made by common consent.

In the Television Bill which has now been laid before the House of Commons an attempt has been made to reach a compromise between the original proposals put forward in the White Paper and the views expressed, particularly in the House of Lords. Thus there are elaborate safeguards against the influence of advertising, and a grant-in-aid of £750,000, to be voted annually by Parliament, is proposed. In any event, it is to be hoped that when the Bill is debated in Parliament there will be less disposition to challenge the sincerity of those who promote or oppose. The analogies drawn between broadcasting and the Press have shown some confusion of thought, but may nevertheless have been inspired by a sincere concern to secure freedom of thought and expression. So too, on the other side, legitimate concern lest commercial interests would be allowed to control the content and context of broadcasting or television may have been expressed in such a way as to impute motives or conduct to advertisers and business men from which Lord Beveridge explicitly dissociated his Committee. None the less, the danger exists, and in fact has been admitted by the Government, the proposals of which are criticized because they are regarded as providing inadequate safeguards here in a matter in which the public interest must be supreme. An agreed solution should be possible, based on hard constructive thinking and a clear appraisal alike of competing claims on national resources, and of the several alternatives to monopoly in broadcasting and television, which are open to us; among the matters which should be considered are the possibilities of regional stations and various technical advances which are in process of development.

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## THE PLACE OF RELIGION IN THE SCIENTIFIC WORLD

### Religion and the Modern Mind

By Prof. W. T. Stace. Pp. vii+301. (London: Macmillan and Co., Ltd.; New York: St. Martin's Press, Inc., 1953.) 21*s.* net.

PROF. W. T. STACE has recently changed his view of the nature of reality, and this book, together with his "Time and Eternity", published in 1952, gives an account of the change and, to some extent, of the reasons for it. Put in the crudest way, his intellectual conversion might be described by saying that, whereas he formerly believed in only one world, now he believes in two. But this, of course, is an unfair statement of a position which deserves the most respectful consideration. "Religion and the Modern Mind" is brilliantly written, and, though the argument is by no means simple, it can be followed easily by any educated person.

Prof. Stace is concerned with the decay of religion which, he thinks, must mean an impoverishment of human life and experience. He traces this decay to the rise of natural science and exhibits very clearly the stages in the process. He does not hold that the development of science led logically to the waning of religious beliefs, or at least of the belief in God, because no scientific discovery or theory could tend either to prove or disprove Theism; but he believes that the non-logical process of thought can be traced by which a religious view of the universe has steadily lost authority over the modern mind. The progress of the scientific interpretation of experience which has "no need for the hypothesis" of Deity has almost insensibly persuaded men that there is no need for the hypothesis for the conduct of life. The conceptions of a 'world-purpose' and of the world as a 'moral order' have faded out of the consciousness of

multitudes who would be quite unable to give reasons for rejecting them.

The remarkable feature of Prof. Stace's position is that he maintains a naturalistic and determinist position with regard to empirical knowledge. When we look at things from the point of view of science, the whole of existence, including our minds and thoughts, is a deterministic order. But this is not the only way of looking at reality. The important thing that has happened to Prof. Stace is that he has become convinced of the validity of mystical experience. His exposition leads one to suppose, in spite of his disclaimer, that he has not only been convinced but has had some personal initiation into the mystic way. However this may be, he goes to the limit with the mystics. The mystical union, for him, is the only bliss that is really worth having. The symbols and doctrines of the great religions are only shadows of the true Reality. Nothing can be said of what the mystic knows, if knowing is the right word; only that the knowing which is beyond knowledge is the highest good. Prof. Stace does not hesitate to draw the logical conclusion. There is nothing in common between the world of empirical experience and the world of mystical insight. From the point of view of science, mysticism is illusion; and from the point of view of mystical experience, the whole of temporal existence and all the events and objects which science studies are "maya"—deceptive appearance. At one point only do the two orders touch—in the soul of the mystic where the Eternal cuts across the passing and impermanent.

Clearly, this far-reaching statement of a deeply considered view would call for a long discussion. Here it is possible only to point out that mysticism may be of a 'comprehensive' type, and there have been great mystics who have found reflexions of the divine Reality in Nature. It is not clear that their experience is less valid than that of the 'exclusive' mystics; and of course, as Prof. Stace is well aware, philosophical difficulties of an insuperable kind arise when we try to think out the implications of this drastic dualism of experience. When God is thought of as 'Wholly Other' we are at a loss to see how He can enter this world or our own lives. Nevertheless, this is a book which deserves to be read both for its masterly presentation of a difficult subject and for the controlled passion which gives life to every page.

W. R. Matthews

## CHEMISTRY OF DAIRYING

### Richmond's Dairy Chemistry

Revised by Dr. J. G. Davis and F. J. Macdonald. Fifth edition, based on the previous revision by G. D. Elsdon and G. H. Walker. Pp. viii+608. (London: Charles Griffin and Co., Ltd., 1953.) 60*s*. net.

THIS is a very welcome revision of a book which has been a standard work of reference on dairy chemistry since 1899. The scope of the book has been somewhat widened since the last revision in 1942 by Elsdon and Walker; but the most important features of their edition have been retained. Recent research has added considerably to our knowledge of the constituents of milk, and the present authors have given a comprehensive review of this in Chapter 2. In a book of this nature it has not been possible to give more than a brief summary of individual researches, but workers who wish to pursue the subject are provided with ample references to original papers, reviews and the titles of recent books on the subject.

A most interesting account is given on the variation in the composition of cows' milk during the past twenty years. This suggests a distinct fall in solids-not-fat, especially since 1939. Provan's figures quoted from his findings in 1949 show a fall in bulk milk from 8·9 to 8·6 per cent. The effect of breed, feeding, climate, health, age, season, etc., is discussed at length in Chapter 3. The freezing point of milk has been fully dealt with as regards its determination and the recent reports of abnormally small depressions. In two of the cases quoted, the depression of the morning milk was normal, but that of the evening milk abnormally small. This appears to have been due to the housing of the cows at night, when they were deprived of water for many hours, the water intake being copious during the daytime. In a third case the cows were kept on a starvation diet.

Useful information is given on the *p*H of milk and milk products, and comparisons are made between the titratable acidity of milk and the corresponding *p*H values. The recent work recorded on the factors affecting the keeping quality of milk powders is of considerable commercial importance and has been given due prominence. The chapters dealing with analysis have been augmented by a most useful account of the detection and determination of enzymes, which includes tests for estimating the degree of heating of milk. Other important additions are methods for the determination of metals in dairy products and statutory tests for milk.

As would be expected from authors who have devoted so many years to the subject of dairy chemistry, the present edition gives a most extensive bibliography. Upwards of twelve hundred original works are referred to and form probably the most complete bibliography on the subject yet published. The text, tables, diagrams, etc., are extremely clear, and this revised edition will be indispensable to the dairy chemist for many years.

J. King

## WESTERN SCIENCE IN RESURGENT ASIA

### Men Against the Jungle

By Ritchie Calder. Pp. 232+15 plates. (London: George Allen and Unwin, Ltd., 1954.) 15*s*. net.

THIS book gives a graphic account of the field-work of the specialized agencies of the United Nations Organization in south-west Asia. A striking feature of the account is the speed with which modern science can be applied to the elimination of disease, hunger and illiteracy. One shot of an anti-biotic can cure yaws, which in some areas affects the majority of the people. In a few months malaria, which affects practically everybody in badly infested districts, can be eliminated. Freedom from these diseases makes the people so much more vigorous and fitter to cultivate the land properly that their food production can be increased by as much as 15 per cent. Apart from major projects like the Tennessee Valley Authority to increase the area of fertile land, simple methods of improved cultivation, the use of fertilizers and selected seeds can increase the yield by 50 per cent.

communication is of such vital importance that it overshadows completely the question of monopoly.

On this point there are two passages in Lord Simon's book which should be noted. In cultural matters, he points out, the B.B.C. has great influence; it does consciously seek—and often with outstanding success—to raise standards and to create new tastes. In politics and in religion, however, it is entirely neutral; its broadcasts are proportional to the demands of organized public opinion and it has no power and shows no initiative, except in freely encouraging to the very best of its ability the broadcasting of information, opinion and discussion by leaders of thought in all religious and political fields. Lord Simon dismisses as unfounded the idea that the B.B.C. is dangerously powerful. Its influence is great and its practice and policy sufficiently diversified to secure reasonable freedom on the air, if not sufficiently so to satisfy all minorities. He regards its influence on the whole as promoting, through its news, talks, discussions and features, an informed and responsible British democracy, more tolerant and wiser than many others.

That much lies to the credit of the public service ideal, though even here the danger is not excluded that broadcasting as well as television, if too much time is given to it, may prove inimical to the formation of independent-thinking citizens of democracy. That danger is bound to be greater if either passes under the influence or control of commercial interests, whose concern with public service is a secondary matter, and whose dependence upon advertising for revenue renders sales promotion a dominant motive. Such a self-denying ordinance as the exclusion of sensational television between the hours of six and eight in the evening is too much to expect in these conditions. Commercial television or broadcasting might conceivably assist the introduction of a higher standard of political commentator. The failure of the B.B.C. to use regular political commentators and so to build up their influence is cited by Lord Simon as evidence of the B.B.C.'s impotence to influence opinion in public affairs in any given direction. Commercial television or broadcasting might remedy this defect of monopoly and facilitate the introduction of commentators of the standard of the best of American commentators. It could equally open the door to the more sensational and irresponsible, and this disadvantage of monopoly may well be corrected more widely by some other means such as the alternative public service concerns, towards which Lord Simon himself leans.

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The debate which took place in the House of Lords on November 25 and 26 gave further indication that many thoughtful people are unalterably of the opinion that to commercialize television would mean both a danger, especially to the young, and a loss of great opportunities for good. That expression of opinion was virtually ignored by Government spokesmen in the Parliamentary debates, and on December 14, in a further letter to *The Times*, the vice-chancellors, while welcoming the Government's pledge against direct sponsoring, urged that the power of television was enormous and that any system which would permit commercial considerations to exercise a determining influence on programmes was most unwise. It would, in fact, have been a dereliction of duty if, as responsible leaders in education, they had not reaffirmed their strong and continuing belief that such a risk should be avoided.

An impressive feature of the report of the Beveridge Committee was that, in spite of an unconcealed distrust of monopoly, the Committee, with one dissentient,

recommended the continuance of the monopoly of the British Broadcasting Corporation as the lesser of two evils. It is now clearer than two years ago that the debate on monopoly has only begun: it is equally clear that, among those who are most alive to all that is involved, there is as yet no general agreement as to the wisest alternative to monopoly—in broadcasting or in television. For this reason the Archbishop of Canterbury's appeal to the Government that it should recognize that its proposals are by no means the only ones, that there may be better alternatives, that the real object should be an agreed solution which will satisfy the great majority of the nation, and that until that search has been made and failed the party machine should not be invoked, found strong support not only in the debate from Lord Beveridge himself, Lord Layton, Lord Waverley and others, but also outside the House. Thus the statement by the Assistant Postmaster-General, Mr. L. D. Gammans, that in preparing legislation the Government would consider carefully and sympathetically any alternative practicable proposals for terminating the B.B.C. monopoly, and the declared objective of the policy indicated in the White Paper on Television Policy "to proceed with caution into this field and to safeguard this medium of information and entertainment from the risk of abuse or lowering of standards", were welcomed.

Nevertheless, there is justification for the belief that the Government has given way to commercial interests and jeopardized the whole future of broadcasting and television in Great Britain. Nothing that was said in the Parliamentary debates by Government spokesmen touched this issue: the argument was never met. Moreover, doubts as to Government intentions and good faith were fanned by another omission. The second objective of television policy was defined in the White Paper as "to reduce to a minimum the financial commitments of the State". The previous White Paper on Broadcasting stated that "in the expanding field of television provision should be made to permit some element of competition when the calls on capital resources at present needed for purposes of greater national importance should make this feasible". On the question as to how far the diversion of resources to the expansion of television is at present justified, the White Paper on Television Policy and Government spokesmen in Parliament were silent. Taken with the Government's implied intention to continue to deduct part of the British Broadcasting Corporation's licence income, the Government's attitude on the financial and materials aspect of television is thoroughly unrealistic. The grave doubts and reservations on these points expressed by the Archbishop of Canterbury and Lord Waverley were completely ignored.

The Archbishop of Canterbury, referring to these passages in the two White Papers, asked how far it is wise at this time to put much more of our national financial and other resources into intensifying the output and accelerating the development of television. It seemed to be taken for granted by Government spokesmen, as well as by others, that the purposes of greater national importance are so well supplied with capital resources that those resources can now be diverted to the lesser purpose of competitive television. That is not a view which is likely to be shared by those who are concerned with the country's effort in scientific and technical research, and the calls which the development of atomic energy is already making on resources. In materials, as well as in trained man-power, the expansion of television is likely to compete for resources which are already failing to meet the full requirements of the Department of Scientific and Industrial Research, the universities, and industry. So far as buildings and equipment are concerned, the condemnation of the policy of both political parties in regard to schools and technical education contained in two recent reports from the Select Committee on Estimates makes nonsense of any proposals for the expansion of television until the glaring defects revealed in these two reports are in the way of being removed by appropriate allotment of the necessary resources of capital and materials, while road development might also reasonably be expected to have a prior claim.

Lord Waverley said little on this particular point; but his comment that there is at least a danger that more and more entertainment in the present circumstances may mean less and less effort left no doubt as to his misgivings. Certainly neither the Chancellor of the Exchequer nor his predecessor in that office, Mr. Hugh Gaitskell, had encouraged the belief that we can yet afford to divert national resources into the production or development of luxuries, such as is television on any serious and responsible view. Prudent consideration of available resources suggests the impartial exploration on non-party lines of the possibilities of terminating monopoly and securing the real advantages of competitive television without the dangers that dependence on revenue from advertising appears to involve.

This position gives further force to some comments of the Archbishop of Canterbury and others on the question of the licence fee for television. The Archbishop's suggestion that the licence fee should be raised as necessary to enable the B.B.C. alone to do its job well or to permit an element of competitive programmes, found support from all sides, even from those who are also prepared to experiment with advertising; and Lord Salisbury's rejection of such a suggestion ignored the Archbishop's sound comment that the licence fee should be such that people paid for what they got and did without amenities for which they could not pay. Nor did Lord Salisbury meet the point that if advertisements were introduced the revenue obtained from them should be used for subsidizing the whole service and thus avoid prejudicing hopelessly the position of the B.B.C., or the argument advanced by Lord Merthyr, Lord Moyne and others that the Government should drop its present practice of taking 15 per cent of the B.B.C.'s licence revenue. It is undoubtedly sound that, as Lord Beveridge remarked in supporting the Archbishop of Canterbury, people should pay directly rather than indirectly for their broadcasting or television.

In the early stages of the discussion, Mr. Selwyn Lloyd rejected any compromise except on the condition that an alternative system should draw some revenue from advertisements, but other spokesmen for the Government were not so unreasonable. Early in the House of Lords debate, the Postmaster-General, Earl de la Warr, had indicated the Government's readiness to consider Parliament's views before definite and detailed legislation was prepared, and even in Lord Salisbury's rather hard speech, he said that, within the broad basic principles of the Government's scheme, the Government was prepared to consider any suggestions that might be made. Lord Salisbury referred particularly to the ideas put forward by the Archbishop of Canterbury and by Lord Waverley as worthy of further study, which notably went far outside the conditions afterwards laid down by Mr. Selwyn Lloyd in the House of Commons debate.

Lord Waverley's remarks in particular deserve to be noted. He believes that no one can at present form a true estimate of the ultimate impact of television upon our economic, social and cultural life. In urging that we should wait before making the surrender involved in the Government's plan—a surrender which he is convinced would lead to a lowering of standards—he asked the Government, while accepting the principle of competition and agreeing reluctantly to the establishment of another public corporation, to look again at the finance and other features of its scheme with the view of eliminating dependence upon advertisements. Sir David Maxwell Fyffe's speech in concluding the debate in the House of Commons on December 15 was pre-eminently reasonable, and seems to hold open again the door which Mr. Lloyd had slammed. Sir David's remark, in connexion with monopoly, that the ultimate safeguard of liberty lies in diversity has implications which augur better for second thoughts by the Government on matters on which the spokesmen in Parliament were silent than might be judged from the general trend of the debates.

How important television is likely to become in moulding the civilization of the future cannot yet be judged, nor is a sound judgment likely to be formed in an atmosphere inflamed by party politics or heated argument over monopoly. There is need for much clearer thinking about the responsible exercise of power in a field relatively new and almost uncharted. Even the specific applications of television in education and the techniques demanded are still a matter for experiment, and there is indeed need that, as Lord Layton urged, as far as possible, our ventures into this new field should be made by common consent.

In the Television Bill which has now been laid before the House of Commons an attempt has been made to reach a compromise between the original proposals put forward in the White Paper and the views expressed, particularly in the House of Lords. Thus there are elaborate safeguards against the influence of advertising, and a grant-in-aid of £750,000, to be voted annually by Parliament, is proposed. In any event, it is to be hoped that when the Bill is debated in Parliament there will be less disposition to challenge the sincerity of those who promote or oppose. The analogies drawn between broadcasting and the Press have shown some confusion of thought, but may nevertheless have been inspired by a sincere concern to secure freedom of thought and expression. So too, on the other side, legitimate concern lest commercial interests would be allowed to control the content and context of broadcasting or television may have been expressed in such a way as to impute motives or conduct to advertisers and business men from which Lord Beveridge explicitly dissociated his Committee. None the less, the danger exists, and in fact has been admitted by the Government, the proposals of which are criticized because they are regarded as providing inadequate safeguards here in a matter in which the public interest must be supreme. An agreed solution should be possible, based on hard constructive thinking and a clear appraisal alike of competing claims on national resources, and of the several alternatives to monopoly in broadcasting and television, which are open to us; among the matters which should be considered are the possibilities of regional stations and various technical advances which are in process of development.

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## THE PLACE OF RELIGION IN THE SCIENTIFIC WORLD

### Religion and the Modern Mind

By Prof. W. T. Stace. Pp. vii+301. (London: Macmillan and Co., Ltd.; New York: St. Martin's Press, Inc., 1953.) 21*s.* net.

PROF. W. T. STACE has recently changed his view of the nature of reality, and this book, together with his "Time and Eternity", published in 1952, gives an account of the change and, to some extent, of the reasons for it. Put in the crudest way, his intellectual conversion might be described by saying that, whereas he formerly believed in only one world, now he believes in two. But this, of course, is an unfair statement of a position which deserves the most respectful consideration. "Religion and the Modern Mind" is brilliantly written, and, though the argument is by no means simple, it can be followed easily by any educated person.

Prof. Stace is concerned with the decay of religion which, he thinks, must mean an impoverishment of human life and experience. He traces this decay to the rise of natural science and exhibits very clearly the stages in the process. He does not hold that the development of science led logically to the waning of religious beliefs, or at least of the belief in God, because no scientific discovery or theory could tend either to prove or disprove Theism; but he believes that the non-logical process of thought can be traced by which a religious view of the universe has steadily lost authority over the modern mind. The progress of the scientific interpretation of experience which has "no need for the hypothesis" of Deity has almost insensibly persuaded men that there is no need for the hypothesis for the conduct of life. The conceptions of a 'world-purpose' and of the world as a 'moral order' have faded out of the consciousness of

multitudes who would be quite unable to give reasons for rejecting them.

The remarkable feature of Prof. Stace's position is that he maintains a naturalistic and determinist position with regard to empirical knowledge. When we look at things from the point of view of science, the whole of existence, including our minds and thoughts, is a deterministic order. But this is not the only way of looking at reality. The important thing that has happened to Prof. Stace is that he has become convinced of the validity of mystical experience. His exposition leads one to suppose, in spite of his disclaimer, that he has not only been convinced but has had some personal initiation into the mystic way. However this may be, he goes to the limit with the mystics. The mystical union, for him, is the only bliss that is really worth having. The symbols and doctrines of the great religions are only shadows of the true Reality. Nothing can be said of what the mystic knows, if knowing is the right word; only that the knowing which is beyond knowledge is the highest good. Prof. Stace does not hesitate to draw the logical conclusion. There is nothing in common between the world of empirical experience and the world of mystical insight. From the point of view of science, mysticism is illusion; and from the point of view of mystical experience, the whole of temporal existence and all the events and objects which science studies are "maya"—deceptive appearance. At one point only do the two orders touch—in the soul of the mystic where the Eternal cuts across the passing and impermanent.

Clearly, this far-reaching statement of a deeply considered view would call for a long discussion. Here it is possible only to point out that mysticism may be of a 'comprehensive' type, and there have been great mystics who have found reflexions of the divine Reality in Nature. It is not clear that their experience is less valid than that of the 'exclusive' mystics; and of course, as Prof. Stace is well aware, philosophical difficulties of an insuperable kind arise when we try to think out the implications of this drastic dualism of experience. When God is thought of as 'Wholly Other' we are at a loss to see how He can enter this world or our own lives. Nevertheless, this is a book which deserves to be read both for its masterly presentation of a difficult subject and for the controlled passion which gives life to every page.

W. R. MATTHEWS

## CHEMISTRY OF DAIRYING

### Richmond's Dairy Chemistry

Revised by Dr. J. G. Davis and F. J. Macdonald. Fifth edition, based on the previous revision by G. D. Elsdon and G. H. Walker. Pp. viii+608. (London: Charles Griffin and Co., Ltd., 1953.) 60*s*. net.

THIS is a very welcome revision of a book which has been a standard work of reference on dairy chemistry since 1899. The scope of the book has been somewhat widened since the last revision in 1942 by Elsdon and Walker; but the most important features of their edition have been retained. Recent research has added considerably to our knowledge of the constituents of milk, and the present authors have given a comprehensive review of this in Chapter 2. In a book of this nature it has not been possible to give more than a brief summary of individual researches, but workers who wish to pursue the subject are provided with ample references to original papers, reviews and the titles of recent books on the subject.

A most interesting account is given on the variation in the composition of cows' milk during the past twenty years. This suggests a distinct fall in solids-not-fat, especially since 1939. Provan's figures quoted from his findings in 1949 show a fall in bulk milk from 8·9 to 8·6 per cent. The effect of breed, feeding, climate, health, age, season, etc., is discussed at length in Chapter 3. The freezing point of milk has been fully dealt with as regards its determination and the recent reports of abnormally small depressions. In two of the cases quoted, the depression of the morning milk was normal, but that of the evening milk abnormally small. This appears to have been due to the housing of the cows at night, when they were deprived of water for many hours, the water intake being copious during the daytime. In a third case the cows were kept on a starvation diet.

Useful information is given on the *p*H of milk and milk products, and comparisons are made between the titratable acidity of milk and the corresponding *p*H values. The recent work recorded on the factors affecting the keeping quality of milk powders is of considerable commercial importance and has been given due prominence. The chapters dealing with analysis have been augmented by a most useful account of the detection and determination of enzymes, which includes tests for estimating the degree of heating of milk. Other important additions are methods for the determination of metals in dairy products and statutory tests for milk.

As would be expected from authors who have devoted so many years to the subject of dairy chemistry, the present edition gives a most extensive bibliography. Upwards of twelve hundred original works are referred to and form probably the most complete bibliography on the subject yet published. The text, tables, diagrams, etc., are extremely clear, and this revised edition will be indispensable to the dairy chemist for many years.

J. KING

## WESTERN SCIENCE IN RESURGENT ASIA

### Men Against the Jungle

By Ritchie Calder. Pp. 232+15 plates. (London: George Allen and Unwin, Ltd., 1954.) 15*s*. net.

THIS book gives a graphic account of the field-work of the specialized agencies of the United Nations Organization in south-west Asia. A striking feature of the account is the speed with which modern science can be applied to the elimination of disease, hunger and illiteracy. One shot of an anti-biotic can cure yaws, which in some areas affects the majority of the people. In a few months malaria, which affects practically everybody in badly infested districts, can be eliminated. Freedom from these diseases makes the people so much more vigorous and fitter to cultivate the land properly that their food production can be increased by as much as 15 per cent. Apart from major projects like the Tennessee Valley Authority to increase the area of fertile land, simple methods of improved cultivation, the use of fertilizers and selected seeds can increase the yield by 50 per cent.

The author shows that the elimination of illiteracy needs no elaborate training colleges for teachers. At primitive educational centres, natives are trained and then go back to their villages to teach old and young to read and, what is equally important, take with them an elementary knowledge of, and enthusiasm for, improved hygiene and agricultural methods which the natives can carry out themselves with their own resources.

As the author shrewdly remarks, this method of getting the natives to carry out the development themselves and by the means they understand avoids the mistake of trying to superimpose a 'pre-fabricated' Western civilization on a totally different social and economic structure. By the improvement of environmental conditions the standard of living rises, and as illiteracy disappears there will go with it the stultifying superstitions and fears of evil spirits and local gods which need to be appeased.

Scientists and politicians might well ponder over the ultimate effects of introducing Western technology to the old civilization of the East. The first result will be a fall in the death-rate and an 'explosion of population' such as occurred in England in the nineteenth century, in which case it would be doubled in fifty years. There is no reason for believing that the Asian, even the wild man of Borneo, is innately inferior, physically or mentally, to the white man. The superior technology of the West, especially in armaments, which enabled the European nations, including the offshoot North America, to get military and economic control of practically the whole world is an open book to the Asians, who now have their own universities and research organizations. All Asia may follow the example of Japan, which within forty years of adopting Western technology became a first-class world power. As the late General Smuts pointed out, the upsurge of Asia is by far the most important political event of our day. Compared with it, European problems are of minor importance.

The most important aspect of the introduction of modern technology to the East is the raising of the standard of living and increasing the physical and mental vigour of the masses which constitute more than half the population of the world, by freeing them from the debilitating effects of disease, hunger and superstition. This development, which will profoundly affect the future of human society and which receives little attention from politicians, is being promoted by the work of the specialized agencies of the United Nations Organization described in this book, which is as readable and as fascinating as a thriller. It can be commended to all those who speculate on the shape of things to come in this rapidly changing world.

BOYD ORR

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# DISSOCIATION ENERGIES OF DIATOMIC MOLECULES

## Dissociation Energies and Spectra of Diatomic Molecules

By Dr. A. G. Gaydon. Second edition revised. Pp. xiii+262+4 plates. (London: Chapman and Hall, Ltd., 1953.) 35*s*. net.

THE twelfth and final chapter of this second edition of Dr. A. G. Gaydon's book is headed: "The Dissociation Energies of Diatomic Molecules; Numerical Values". An extensive compilation of data follows, covering some 275 molecules. The merit of these tables lies not only in the values recommended, but also in the assessment of the probable error limits to be associated with each of the values given. In comparatively few molecules are the dissociation energies known precisely. Dr. Gaydon lists twenty-two molecules for which the error limits lie within $\pm$ 0·01 eV., and there are a further thirty-seven molecules for which the error limits are given as $\pm$ 0·1 eV. At the other extreme there are sixty-seven cases in which the error limits range from $\pm$ 0·5 to $\pm$ 2 eV., and thirty-nine cases where a question mark is attached to the recommended value. Of the dissociation energies given by the author in the first edition, published eight years ago, no less than one-third out of a total of two hundred and fifty are now altered to a greater or lesser extent.

The major revisions in the new edition are to the last four chapters, which have been largely re-written. In these the author deals with several diatomic molecules for which the dissociation energies remain both in doubt and subject to much controversy. These controversies rage most violently in the important cases—practical and theoretical—of the dissociation energies of $N_2$ and CO, and—in lesser degree—of $F_2$ and $S_2$. Dr. Gaydon joins combat with these issues with spirit and force, and presents his conclusions most persuasively.

I am inclined to agree with Gaydon's choice of values, $D(F_2) = 1{\cdot}6$ eV., and $D(S_2) = 4{\cdot}4$ eV. Recent evidence by Doescher[1] (mentioned, but not elaborated upon, in the book), by Haar and Beckett[2], and by Barrow[3], supports the chosen fluorine value, and the work of Sehon[4] and Porter[5] is difficult to reconcile with the alternative values (3·3 eV., 3·6 eV.) that have been proposed for $D(S_2)$. The case presented for the value $D(N_2) = 9{\cdot}76$ eV. is certainly strong, and indeed might have been strengthened further by mention of the studies of Kistiakowsky[6] on the detonation velocities in mixtures of gases containing cyanogen, oxygen and nitrogen. Nevertheless, some doubts linger, and although the author clearly wins the debate into which he enters, one feels that decisive experimental proof is not yet available.

The problem of the dissociation energy of CO is tied to that of the latent heat of sublimation of graphite, $L(C)$. Dr. Gaydon favours the value $D(CO) = 11{\cdot}11$ eV., and hence the so-called 'high' value, $L(C) = 170{\cdot}0$ kcal./mole, but he qualifies his choice with the warning: "it is wise not to be too dogmatic".

Attempts to measure $L(C)$ directly—and these have been several—have now occupied a period of thirty years. This long-standing problem is perhaps fairly to be described as exasperating, for despite careful and determined attacks upon it by able experimentalists, the answer cannot yet be quoted with certainty. But the challenge is being met with vigour, and one feels the problem can scarcely resist solution for much longer. Indeed, the latest studies (Chupka and Inghram[7], Honig[8]) would seem to expose the hub of it.

H. A. SKINNER

[1] Doescher, *J. Chem. Phys.*, 19, 1070 (1951).
[2] Haar and Beckett, Nat. Bur. Standards Rep., No. 1586 (1952).
[3] Barrow and Caunt, *Proc. Roy. Soc.*, A, 219, 120 (1953).
[4] Sehon, *J. Amer. Chem. Soc.*, 74, 4722 (1952).
[5] Porter, *Disc. Faraday Soc.*, 9, 60 (1950).
[6] Kistiakowsky, Knight and Malin, *J. Amer. Chem. Soc.*, 73, 2972 (1951).
[7] Chupka and Inghram, *J. Chem. Phys.*, 21, 1313 (1953).
[8] Honig, *Phys. Rev.*, 91, 465 (1953).

## La Chimica delle Fermentazioni

Microbiologia, Enzimologia, Chimica e Tecnica delle Fermentazioni. Da Virgilio Bolcato. Seconda edizione. Pp. xxiii+665. (Bologna: Nicola Zanichelli, 1952.) 5,000 lire.

THIS book is divided into four parts: elements of general microbiology; enzymology; chemistry of fermentations; and technique of industrial fermentations. One of the virtues of the book is the excellent background and perspective to the pith of the dissertation (Part 3) provided by the other parts. In Part 3 itself, not only are modern views on the mechanisms of various fermentations presented, but also older schemes are critically discussed. A further desirable feature is the description of the methane fermentation, which is frequently neglected in text-books.

The main weakness of the book perhaps resides in undue brevity in certain sections, or in actual omissions. Thus, the reviewers feel that, in Part 1, more detailed treatment should be given to the role of micro-organisms in Nature, with particular reference to the carbon and nitrogen cycles. Again, the section on classification of micro-organisms would benefit by precise definition of the bacteria, yeasts and moulds in the organic world, and by some detail of the chief families and genera comprising the bacteria. The production of antibiotics is not treated. Reference is made to quite recent developments in enzyme chemistry, often, however, most briefly, although references are given. Indeed, there are a good, up-to-date bibliography, and subject and author indexes.

Whatever its shortcomings, the virtues of the book far outweigh them. It is unfortunate that this book does not exist in English translation, for it is admirably suitable as a text-book for students of microbiological chemistry and the associated field of plant biochemistry.

R. H. HOPKINS
C. RAINBOW

## A School Course in Mechanics

By A. J. Bull. Part 2. Pp. viii+157–408. (Cambridge: At the University Press, 1953.) 15*s*.

THIS volume, together with its more elementary companion, Part 1, is designed to provide a continuous course reaching the standards required for the papers at Advanced and Scholarship levels for the various General Certificate of Education examinations, though the author states that students wishing to prepare for open university scholarships will need to supplement it by some other book. There is no doubt that, on the whole, the author has admirably succeeded in his aim. There is evidence of a well thought-out plan and a very satisfactory presentation which suggest that Mr. A. J. Bull has great enthusiasm both for his subject and the teaching of it.

In this volume, calculus is, quite properly, used freely, and there is a wide selection of questions, many of university standard; in addition, quite a number of typical questions are fully worked out in the text.

The need for practical work as an integral part of the course is stressed, though it must be said that the author does not approach many of the topics from the experimental aspect. This makes the book severely theoretical, and although those who are more mathematically minded will not be affected, the reviewer feels that an experimental approach to some of the problems dealt with would be helpful to the more ordinary student. There can be little doubt, however, that in his own teaching practice, Mr. Bull does introduce practical work in support of the text-book theory, and he exhorts other teachers to do likewise.

## ASTM-IP Petroleum Measurement Tables

British edition: British (Imperial) Units of Measurement. Prepared jointly by the American Society for Testing Materials and the Institute of Petroleum. Pp. xv+416. (London: Institute of Petroleum, 1952.) 50*s*.

ONE of the latest joint efforts of the American Society for Testing Materials and the Institute of Petroleum is the publication of "ASTM–IP Petroleum Measurement Tables" (official designations being respectively D 1250 and IP 200), based on collective work started in 1946. The magnitude of the task can be readily imagined when it is realized that this and companion volumes contain thirty-nine tables involving some six hundred thousand six-digit figures (nearly four million digits); well over a quarter of a million IBM cards, weighing more than two tons, were employed in their make-up. These tables meet a demand from the oil industry and are authoritative in a computation of British (Imperial) units of weights and measures. They form part of a trilogy, including volumes devoted to United States and metric systems. The present (British) book includes tables for specific gravity and volume reduction to 60° F., and for weights per unit volume and volumes per unit weight over the gravity range 0·500–1·000, generally at intervals of 0·001. There are twenty-three separate tables in this volume, each of which is preceded with information as to purpose of the table, and also examples of how to use the data given. The completeness and accuracy of these tables are a major credit to all concerned in their compilation and, moreover, ensure a heavy international demand for this work, not only in the petroleum industry but also in a much wider field of applied science.

H. B. MILNER

## Alternating Current Wave Forms

Theory and Practice. By Philip Kemp. (Monographs on Electrical Engineering, Vol. 1.) Second edition, revised and enlarged. Pp. xi+406. (London: Chapman and Hall, Ltd., 1952.) 50*s*. net.

MR. PHILIP KEMP'S book dealing with alternating current wave forms is one of considerable general utility to electrical engineers. It deals with the synthesis and harmonic analysis of complex periodic waves, and with the properties of such waves in relation to electrical networks.

Only elementary mathematics is involved, and the book is very suitable for the use of undergraduate students. A good deal of attention is given to the harmonic-generating properties of circuits with iron-cored reactors, and the production of harmonics by cyclic variation of resistance is also considered. Harmonics in polyphase systems and in transformers in various systems of connexion and when supplying rectifiers are treated in two chapters. Two further chapters are devoted to the study of harmonics in the flux waves in electrical machines, and to the generation of harmonic e.m.f.'s in alternating-current windings.

The book gives a good general, but necessarily not detailed, treatment of the main features of the subject, both theoretical and practical.

# NATURE CONSERVATION IN BRITAIN

ALMOST exactly five years have elapsed since the Nature Conservancy was constituted by Royal Charter "to provide scientific advice on the conservation and control of the natural flora and fauna of Great Britain; to establish, maintain and manage nature reserves in Great Britain, including the maintenance of physical features of scientific interest; and to organize and develop the scientific services related thereto". It is therefore a matter of some interest that the first two reports[1], one relating to the work of the Conservancy up to September 30, 1952, the second for the year ended September 30, 1953, have recently been published. It is to be hoped that the form of the second of these reports justifies the assumption that, as laid down in Section 24 of the National Parks and Access to the Countryside Act, 1949 (12, 13 and 14 Geo. 6, Ch. 97), the Nature Conservancy will "as soon as possible after the thirtieth day of September in each year, make to the Lord President of the Council a report on the discharge by them of their functions during the period of twelve months ending with that day".

Although to some extent the way has been paved for the Nature Conservancy by the pioneer work of the Royal Society for the Protection of Birds, the National Trust, the Society for the Promotion of Nature Reserves and a few other and more local societies, nevertheless the Nature Conservancy faces a formidable task, and one which seems likely to become more and more difficult of achievement as the impacts of new claims for land, and of modern techniques of land usage, reach their maximum demands. Many of the most interesting species of plants and animals of Britain have already become restricted, as a result of agricultural development and of urbanization, to marginal lands. Now these same retreats are the objects of competition among hill graziers, foresters, new industries and the Armed Forces. Moreover, the Nature Conservancy was constituted immediately following a succession of years during which dramatic changes were imposed upon many areas under the demands of war-time economy. War agricultural committees drained and ploughed much land which had never before been cultivated, huge acreages were disciplined into landing fields, industry was dispersed widely into former rural areas, and battle-practice schools took over many square miles of land as gunnery and bombing ranges or for manœuvres with armoured vehicles.

It is not surprising, in view of this, that, despite the preparatory work of the Nature Reserves Investigation Committee and, following that, of the Wild Life Conservation Special Committee, it has proved necessary to organize a complete survey of England and Wales in order to determine the conditions now existing, and so to provide, as it were, an up-to-date register of the status of the wild life of the country, and at the same time to determine what measures may now be necessary in order to conserve what we have left of it. It is satisfying to read that such a survey was very nearly complete by 1952, and by September 1953 more than one thousand sites had been listed in England alone as being of sufficient importance to merit notification to local planning authorities under Section 23 of the 1949 Act. The protection granted thereby is by no means complete, but it ensures that the Conservancy will be consulted before any new development is permitted which may modify the conditions within such a listed area.

In a country so small and densely populated as Britain, the establishment of Nature reserves is not lightly to be undertaken. Land is a scarce commodity, and its use must be fairly and wisely allocated among the many claimants for it. Moreover, the proper maintenance of a reserve for scientific study demands the goodwill and understanding of the public. Some reserves have been maintained for many years, notably under the ægis of the National Trust and by such bodies as the Royal Society for the Protection of Birds, the Society for the Promotion of Nature Reserves and the Norfolk Naturalists' Trust; readers of the present reports will note with satisfaction the mutual co-operation which the Conservancy has established with these bodies. The establishment of new national reserves is proceeding commendably slowly in view of the need for very careful selection. The view expressed in the second report by the Conservancy that this rate is disappointingly slow may be discounted. Eleven sites have been declared in England and Scotland, and another twelve acquired too recently for declaration to have been completed by the end of the Conservancy's year. By far the largest are the Beinn Eighe Reserve near Loch Maree and the Moor House property in Westmorland, both of which comprise some 10,000 acres. The remainder are smaller areas, many of them reserved for their special interest, such as the famous yews of Kingley Vale, the breck conditions of Cavenham Heath, the fens, broads and sand-dunes of various Norfolk and Suffolk sites, and the remarkable broken cliff conditions of the Dowlands landslip in east Devon. Some of these have already been in the care of a national or local society, which has now transferred the trusteeship to the Conservancy; others have been leased or purchased, while yet others, including the sites of both the Piltdown and the Swanscombe skulls, have been presented.

Section 21 of the 1949 Act empowers local authorities, in consultation with the Nature Conservancy, to create local Nature reserves. Little surprise will be expressed that to date very few authorities have taken such powers. One Scottish and two English county councils have, however, shown their practical interest, and it is not over-optimistic to expect that the number of such local reserves may increase steadily, if but slowly. No doubt the still existent framework of the old Nature Reserves Investigation Committee's county sub-committees can be of use here, in bringing to the attention of their local authorities habitats which require protection and for which the establishment of a local reserve may be feasible.

The wider functions of the Conservancy, namely, the provision of advice upon, and the promotion of research into, the conservation and control of natural populations, present a multitude of problems, not the least of which is our fundamental ignorance of the ecological factors which determine the status of even the commonest of our animals and plants. The science of ecology is still young, and the rate at which

its study yields comprehensive results must be slow, because of the nature of its material and of the intricacy of the complex of physical and biotic factors within which all living organisms exist. It seems, therefore, that the Nature Conservancy may for some years be at best a one-eyed adviser, except where problems relate to only the most simple factors. It is relevant to emphasize that in the case of each of the four examples quoted in the first report no adequate answer could be returned. In fact, the reply was virtually, "We do not know, but we will try to find out", and research has been initiated in an effort to discover the solution.

To biologists therefore, as indeed to all who are prepared to take an objective view of conservation, the most interesting and stimulating sections of these two reports are those announcing the establishment and organization of the Conservancy's own research stations, at Merlewood, with Moorhouse at its doorstep, at Anancaun in the Beinn Eighe Reserve, and at Furzebrook in Dorset. Coupled with this must be Appendixes V, VI and VII to the second report, in which are listed the grants awarded to universities and other organizations for the development of research into specific field-problems. One of the strongest deterrents to the initiation of fundamental ecological research, particularly in relation to animal populations, has been the breadth of the task which must be faced. Even the so-called autecological study of the bionomics of a single species must involve the investigator in an infinitude of problems in which the physical factors of climate and microclimate, geology and soil structure and physiography may be involved, while willy-nilly an extensive study of the lives and relationships of a greater or lesser number of other species must be examined in order to determine the nature of their influence upon the species in which the worker is primarily interested. He must therefore be equipped in some measure as meteorologist, pedologist, taxonomist and statistician, and in a host of other techniques. Few men and women are able to attain to this width of interests, and in practice aid is sought from other experts in the solution of the many problems which have to be examined.

Synecology—the study of whole habitats and of the total assemblages of plants and animals within them—presents a still greater complexity of pattern, and demands so high a degree of concentration, knowledge and labour that few investigations of this kind have been successfully concluded. Nevertheless, the autecology of any species cannot be elucidated without reference to the synecology of the habitat in which it lives. It follows, therefore, that the ultimate aim of ecological science must involve a detailed synecological picture of at least the major habitats of the world. Only then will it become possible to assess correctly the status of the individual species; and, from the point of view of human welfare, only then will it become possible to prophesy the consequences to be expected from any attempt to modify the status of a species, whether by encouragement, control or, in the final event, extermination.

It seems logical to expect that comprehensive ecological knowledge can only be attained through the work of teams of experts in groups of related fields, and it is therefore encouraging to observe the nucleus of one such team being created in the scientific staff of the Nature Conservancy. It is to be hoped that, once the organization has escaped its growing pains, its scientists will be freed from all but the necessary minimum of administrative and advisory duties, in order that they may concentrate on research. Concurrently, the programme of assistance to universities and to reputable naturalist organizations is warmly welcome. There is a wealth of talent among amateur naturalists, about which they themselves are frequently unduly humble. The exact observer who is prepared to devote his leisure to the ordered study of an area, or of a group of animals or plants, can, and does, make as important contributions to biological knowledge as do many professional scientists. Indeed, the increased load of administrative and teaching duties which besets the university teacher is usually now so heavy as virtually to preclude him from spending sufficient time, at the right times, in the field. As a result, much of his ecological work must be done by proxy. It is here that the training and research grants made by the Conservancy to university departments are so important. Thus, not only is a continual stream of apprentice recruits provided, but also the experienced ecologist is enabled to stimulate and direct work for which he himself no longer has time or freedom.

In conclusion, it is relevant to refer to the 1947 report of the Wild Life Conservation Special Committee[2]. This committee examined the problem which has been adumbrated in the foregoing paragraphs, and made a number of recommendations, of which the most stimulating was perhaps that mooting the idea of freedom of movement of members of staff between museums, the Nature Conservancy and university departments. The ecological worker would thereby gain a wide experience of different disciplines, techniques and methods of attack upon his problems. Such increased versatility is so patently desirable as to create the hope that the idea has not been pigeonholed and forgotten.

L. A. HARVEY

[1] The Nature Conservancy. Reports of The Nature Conservancy for the period up to 30th September 1952. Pp. iii+33. 1*s.* 3*d.* net. Report of The Nature Conservancy for the Year ended 30th September 1953. Pp. iii+31. 1*s.* 3*d.* net. (London: H.M. Stationery Office, 1953.)

[2] Conservation of Nature in England and Wales. Cmd. 7122. (London, 1947.)

## RECENT ADVANCES IN ANIMAL MORPHOGENESIS

THE conference sponsored by the editorial board of the *Journal of Embryology and Experimental Morphology* and held in London during January 9–12 permitted a large number of biologists to hear and discuss accounts of recent work on many major aspects of animal morphogenesis. For this opportunity they were primarily indebted to their Continental colleagues, whose participation has provided an important stimulus to British interest in this field.

That rewarding work may still be found in the exploration of the classical problems of embryology was shown by Prof. J. Pasteels (Brussels), who described the first fruits of an investigation of embryonic stages of reptiles from the Belgian Congo. He has been able to show that the migration of the primordial germ cells to the gonadal ridges by a vascular route, long known in birds and *Sphenodon*, occurs also in lacertilians. A study of body form and brain morphology in species of different habits showed that relative functional importance in the adult can be anticipated by the embryo at a remarkably early stage. The brains of embryo

chameleons (animals which in the adult rely largely upon their visual sense) and those of the embryo *Mabuia* (in the adult largely olfactory) show early differences in the size of optic and olfactory centres. Similar considerations seem to govern the form of the body generally and of the limb, both of which in adult lacertilians may show wide differences in form and function.

Although the general configuration of the embryo can show a precocious anticipation of the functional adaptations of the adult, things are not necessarily the same at the histological level. Prof. A. Stefanelli (Rome) described cells within the optic tectum of teleost fishes which are bipolar in form and possess a recurrent branch arising from the outer fibre. To see how far their differentiation was dependent upon function, studies were made of their development in oviparous fish; in viviparous fish, in which animals before and after birth were compared; and in blind cave fish compared with related forms with vision. Blind fish, in which the eyeball is normally nearly completely enclosed in a bony capsule and in which there is no functional optic nerve, may nevertheless possess some of these neurones with their major features intact. Blindness in this species seems to have led to a reduction in the number of neurones subserving vision without altering the general features of the histogenesis of those surviving.

Prof. F. E. Lehmann (Berne) has made an electron microscope study of the cytoplasmic constituents of blastomeres of known morphogenetic properties from the eggs of the oligochæte *Tubifex* and of the sea-urchin. The technical problems of preparing the material have been overcome by treatment with glycerine or sucrose, which makes the cells brittle and easy to isolate from the germ and also dehydrates them sufficiently to inhibit autolysis. Fixation by osmium tetroxide provides good preservation of mitochondria, but a more acid fixative is required for the study of microsomes. The cells studied in the *Tubifex* germ were the somatoblasts 2*d* and 4*d*, the first giving rise to ectoderm and the latter to mesoblast in normogenesis. The cytoplasm of these cells was shown to differ in the density of the population of mitochondria—4*d* having many more than 2*d*—and in the nature and numbers of smaller inclusions. The microsome populations of different cells in the sea-urchin blastula also showed characteristic differences. In the micromeres are found many small microsomes, while there is a gradient in the concentration of mitochondria from animal to vegetal pole with a maximum at the animal pole.

Prof. Chr. P. Raven (Utrecht) gave an account of the effects of lithium ions on the development of *Limnaea stagnalis*, and of some ways in which these effects could be modified. Treatment with lithium chloride may induce exogastrulation and cyclocephalic malformations—in extreme cases cyclopia itself. These two effects are, however, independent, and it is suggested that the effect of lithium is both to weaken an animal field and to disturb the vegetal pole material. There is evidence that exogastrulation and cyclopia are independent consequences of a causal chain in which the lithium has a primary effect mediating a secondary disturbance of the respiratory processes which is responsible for the observed tertiary effects. Combinations of other ions with lithium show that while potassium, if anything, increases the lithium effect, either calcium or potassium cyanide may exercise a protective function. Conditions of oxygen lack, which in themselves induce exogastrulation, are not so effective in presence of lithium ions. Concentrated potassium cyanide and heat shocks may both imitate the lithium effect. Dilute potassium cyanide under conditions of anaerobiosis increases the effectiveness of the latter as an agent causing exogastrulation. Exogastrulation, but not cyclopia, can be produced by centrifugation.

The mammalian egg, still largely inaccessible to the surgical procedures used on lower vertebrates, is coming to assume its rightful place in contemporary embryological advance by the application to it of the methods of cytochemistry, and Prof. A. Dalcq (Brussels) showed how great the recent increase in our knowledge of its biochemistry has been. Studies on mitochondria and other visible particles in the maturing oocyte during fertilization and the early stages of development have been combined with examinations of the distribution of nucleic acids, polysaccharides and alkaline phosphatase. During oogenesis the most important changes seem to concern the microsomes and larger visible granules, these being active in the synthesis of cytoplasm and metaplasmic inclusions. Nuclear extrusions are also important at this stage. Fertilization sees little change in the visible cytoplasmic particles; but nuclear activation is accompanied by a temporary reduction in the deoxyribonucleic acid of both sperm and oocyte nuclei. The deoxyribonucleic acid is, however, rapidly recovered as the pronuclei form. Early development sees the first appearance of alkaline phophatase. Bilateral symmetry, already apparent in the distribution of cell constituents in the maturing oocyte, becomes marked in the later cleavage stages, and from this time onward differences in the cytoplasmic constitution of cells with different fates become apparent. To some extent it is already possible to explain the biochemical activity of these cells in terms of their capacity for performing certain morphogenetic functions.

Prof. S. Hörstadius (Uppsala) described a further analysis of the organization of the young sea-urchin germ. The reduction of Janus green in cells under conditions of diminishing oxygen tension can be used to distinguish between regions of the egg with high and those with low metabolic activity. In such conditions a normal egg will show reduction (that is, high metabolic activity) first at the vegetal pole, then in the apical region and last of all in the region of the ciliary band. Isolated animal and vegetal halves in these conditions display simultaneous onset of Janus green reduction, and this indicates that the vegetal region normally inhibits the apical one. Micromeres implanted into the side of the animal hemisphere induce a reduction centre there, and are also effective in distorting the gradient in mitochondrial density that runs from animal to vegetal poles. Work with anti-metabolites had revealed a rather surprising phenomenon, since while 8-chloroxanthene (blocking purine and nucleic acid metabolism) had an animalizing effect and phenyllactic acid (blocking amino-acid metabolism) had a vegetalizing effect, *both* gave rise to a number of peculiar radially symmetrical larvæ of a kind that Gustafson had produced with detergents. Both substances were, in fact, acting in this way, though it is open to question how far this is relevant to their other morphogenetic effects.

In the classical experiments on neural induction in the urodele embryo the structures induced were either ectodermal in nature or associated with ectodermal inductions. It has now proved possible to

induce structures of wholly, or almost wholly, mesodermal nature. Prof. S. Toivonen (Helsinki) reported a study of inductions produced by alcohol-treated guinea-pig bone marrow after its implantation into the gastrula or when placed in ectodermal 'sandwich' explants. It is noteworthy that the tissues induced in such experiments are those which in normogenesis would arise from both endomesoderm and ectomesoderm. Secondary inductions sometimes, but by no means always, occur. The same inductor if further treated with hot water for a short period undergoes a remarkable change in properties. It now induces only structures arising in normogenesis from the ectoderm, for example, lenses and balancers, though rarely, if ever, neural cells. Prof. Toivonen believes that this change is not due to a transformation of the mesoderm inductor but results from its complete destruction, with the consequent unmasking of an ectodermal inductor that had previously been unable to express itself.

Prof. J. Brachet (Brussels) described a technique for the autoradiographic localization of labelled atoms developed in his laboratory by Mme. A. Ficq. It uses the thick emulsions prepared for the study of cosmic radiation. The method permits of the location of labelled atoms with a resolution of about 1 micron. Experiments on the oocytes of *Asterias* using marked glycine showed that the activity of the nucleolus was nearly a hundred times as great as that of either nuclear sap or cytoplasm after one hour's treatment. When applied to the process of embryonic induction the method revealed that when either labelled glycine or orotic acid is incorporated into an amphibian organizer that is then implanted into another gastrula, radioactivity can later be detected not only in the secondary neural tube but also, to a lesser extent, in the host's normal nervous system. The method can also be used to identify lithium if the preparations are subjected to neutron bombardment which splits the lithium atoms. It has been possible in this way to demonstrate a distinct accumulation of lithium in the dorsal half of amphibian gastrulæ formed from eggs treated with 1 per cent lithium chloride.

Prof. C. H. Waddington (Edinburgh) reported the methods being developed in his laboratory using radioactive amino-acids and the stripping film method in the study of embryonic processes in amphibians and birds. Using radioactive methionine and glycine, it had proved possible to get usable concentrations in axolotl and *Xenopus* embryos, and radioactive methionine could successfully be introduced into chick embryos by injecting the albumen in the neighbourhood of the blastoderm and maintaining the egg at room temperature for 12–24 hr. Preliminary results suggested that significant differences in the subsequent radioactivity of different organ rudiments could be detected.

From Prof. Waddington's laboratory there also came a film, exhibited by Dr. D. A. Ede, of the development of *Drosophila*. A surprising amount of the morphogenetic activity from fertilization onwards can be seen by time-lapse cinematography of the whole egg, and shots of eggs doomed to early death by their genetic constitution showed that the method holds great promise for the study of abnormal development.

For workers on the Protozoa, cell division does not serve morphogenetic processes so much as itself set the scene in which morphogenetic processes must necessarily play their part. Prof. E. Fauré-Fremiet (Paris) described some of the processes which accompany the division of the ciliate *Urocentrum turbo* into an anterior individual or proter and a posterior one or opisthe. In this species the kinetosomes of the meridional kineties are so arranged as to lie in circular transverse lines ending in an anterior belt or fascia and an equatorial cingula. At the onset of division the cingula widens by the multiplication of its kinetosomes. It is thus a morphogenetic zone corresponding to Calkins's division zone. The cingular kinetosomes then become distributed along the meridional somatic kineties to complete the morphogenesis of the anterior part of the opisthe and the posterior part of the proter. The oral ciliation presents an autonomous system with its own morphogenetic zone.

Prof. E. C. Wolff (Strasbourg) described the progress made in his laboratory in the attempt to replace chick embryo extract by known mixtures of amino-acids as a medium permitting the survival, differentiation and growth of rudimentary organs *in vitro*. Using the syrinxes, tibias or the gonads taken from bird embryos of 7–9 days incubation as explants, media composed of agar, glucose and saline to which amino-acids and vitamins had been added were tested for their power to sustain growth and differentiation over a seven-day culture period. Growth in the explants was judged by the presence of mitoses and more particularly by the increase in total nitrogen. Marked growth and differentiation in media containing many amino-acids had been obtained; but when an attempt was made to find the minimum requirements of amino-acids for the explants it was discovered that though growth can occur in media to which only a few had been added, the requirements of different organ-rudiments are not the same.

Mr. M. Abercrombie (London) described observations on chick heart fibroblasts in tissue culture which had suggested that 'contact inhibition' was an important factor determining the behaviour of the individual cells and some of the properties of the whole culture. By 'contact inhibition' is meant inhibition of movement, in directions normal to the plane of contact, in two contiguous cells. The evidence for the existence of this phenomenon comes mainly from the behaviour of the outgrowths from two neighbouring explants at their zone of junction in a fluid medium. The failure of the outgrowths to 'overlap' or be thrown into folds bears striking testimony to the unwillingness of their cells to climb over one another. Contact inhibition is not only consistent with well-known features of fibroblast cultures, but may actually explain many of them. Interactions between outgrowths of explants from different organs, and even from different species, go to confirm the generality of the phenomenon, while the three-dimensional outgrowths from explants in plasma clots show it in conditions more nearly comparable with the situation in which fibroblasts occur in the organism.

A number of the papers were accompanied by demonstrations of research material, and in addition such material was presented by Dr. S. M. Manton and Mr. K. T. Anderson illustrating maternal-embryonal connexions in viviparous Onychophora, by Prof. P. B. Medawar, Dr. R. E. Billingham and Mr. L. Brent to illustrate the principle of actively acquired tolerance of foreign cells in mammals and birds, and by Dr. D. R. Newth on the behaviour of lamprey neural crest cells in homoplastic and xenoplastic transplantation.

Dr. R. A. Beatty, Dr. M. Fischberg, Dr. J. Needham, Dr. Muriel Robertson, Prof. J. Z. Young and a number of others contributed to the discussions on the papers read.

A most valuable discussion on the nature of inducing stimuli, led by Prof. J. Pasteels, was also held. It showed that interest in this subject is still high, and that the seemingly formidable difficulties that blocked the search for a single chemical or physical agent of neural induction have not prevented the accumulation of ever more precise information on the biology of the process.

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D. R. Newth

# METALLIC TRANSFER IN SCREWING AND ITS SIGNIFICANCE IN BONE SURGERY

By Dr. F. P. Bowden, F.R.S., and J. B. P. Williamson

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Earlier experiments have shown that when two metals are placed in contact, appreciable metallic transfer occurs from one surface to the other. If sliding takes place, the amount of metal transferred is increased considerably. A general account of this work has been given elsewhere[1].

In simple mechanical operations such as screwing or bolting, we may expect that some transfer will occur between the screwdriver and the screw or the spanner and the bolt. Although the transfer will be small, it may under certain conditions be important. For example, in modern surgery it is customary to use metallic plates to strengthen or to repair a fractured bone. These are screwed or bolted on to the bone and may remain permanently in position. The plates, screws and bolts are all made from a stainless steel which has a very high corrosion resistance. Intensive investigations have been undertaken in recent years to select the best steel for this purpose. It has been found that steel of the specification shown in Table 1 (*a*) is one of the most inert when in contact with human tissues[2]. It was also found that if metal alloys of differing compositions are placed in contact in the human body, metal corrosion and 'electrolytic inflammation' in the tissues occur[3]. 'Electrolytic inflammation' consists in the inflammatory cells of the tissues becoming more numerous and an increased local vascularity of bone and soft tissue. This condition interferes with the normal healing of bone and soft tissues and may eventually produce heavy scarring. Orthopædic surgeons therefore take great care that all plates and screws which are to be left in contact are made of the same alloy. The insertion of 'mixed metals' is always avoided. These plates and screws are electrolytically polished and are passivated in nitric acid. Nevertheless, it is found in practice that inflammation and corrosion do occasionally occur.

Table 1

| (*a*) Specification for screws and plates (per cent by weight) | | (*b*) Specification for tools (per cent by weight) | |
|---|---|---|---|
| Carbon | 0·07 | Carbon | 0·17 |
| Silicon | 0·30 | Silicon | 0·24 |
| Manganese | 0·5 | Manganese | 0·2 |
| Chromium | 18·0 | Chromium | 13·6 |
| Nickel | 8·0 | Nickel | 0·34 |
| Iron | 70·38 | Iron | 85·43 |
| Molybdenum | 2·75 | | |

The screwdrivers, spanners and forceps used in this form of bone surgery are also made from stainless steel, but of a composition differing from that of the plates (see Table 1 *b*) and are less resistant to corrosion.

If small fragments of this different steel are welded on to the screws during the screwing operation, they may, when immersed in the body tissue, form small electrolytic couples which cause inflammation and accelerate corrosion. Experiments were therefore carried out to investigate whether metallic transfer occurred and to determine its amount and distribution. Measurements showed that the steel for the tools was appreciably softer (V.P.H. 150) than the steel for the screws and plates (V.P.H. 380).

*Experimental.* The experiments consisted of driving the screws with a screwdriver having a radioactive tip, and then determining the amounts of metal transferred from the driver to the screw heads by measuring their acquired radioactivities. In order that the forces involved should approximate as closely as possible to those occurring in an actual operation, the screws were driven into bone. The experiment was carried out using samples of splints and self-tapping screws manufactured for medical use, and a splint was fastened by four screws to a leg bone taken from fresh beef. The screws were started by drilling a small hole in the bone with an electric hand-drill and were then driven home and tightened with a screwdriver. This driver had a normal handle and shank, but, instead of a tip, had a small hole recessed into its end. Into this hole a slab of metal $\frac{1}{16}$ in. × $\frac{1}{4}$ in. × $\frac{1}{2}$ in. cut from the tip of an actual medical screwdriver was inserted and used as the screwdriver tip.

Before the experiment, this slab was irradiated in the neutron pile at Harwell and acquired a radioactivity of about $\frac{1}{2}$ mc. For the present purpose only the activity of the chromium in the steel was significant. This consists of *K*-radiation and $\gamma$-radiation of 0·323 MeV. The screws and the driver were degreased with suitable solvents and the first screw was driven home firmly but carefully, so as not to cause appreciable slip between the driver and head. The driver slipped slightly in the slot while the second screw was being driven in; and two deliberate slips were made along the slot of the third screw. The fourth screw was driven and tightened with the utmost caution, and no slip was perceptible.

A Geiger counter was used for measuring the acquired activity of each head. Only $\gamma$-rays were counted. Thus any radiation emanating from transferred metal adhering to the bottom of the slot was not shielded by the mass of the screw head, and the entire amount of adherent metal was recorded.

*Results.* The specific strength of the radioactive metal was measured by counting the $\gamma$-emission from the slab used as the screwdriver tip, in the same Geiger counter under the same geometrical conditions; the weight of this slab having been determined before irradiation. In this way the mass of metal trans-

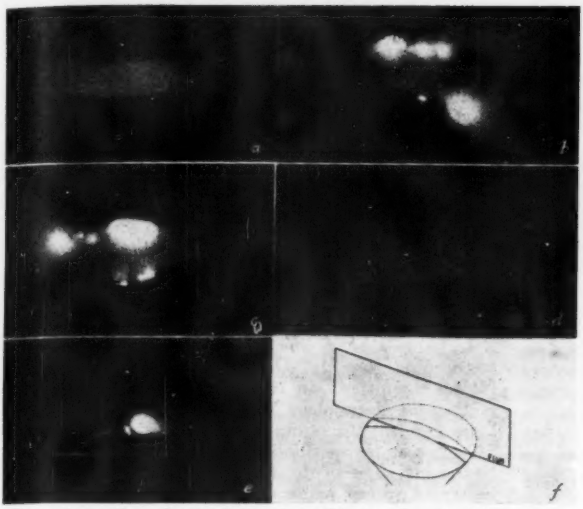

Fig. 1. Autoradiographs of radiation given off by transferred metal on screws. (*a*) 1st screw driven carefully, 22 μgm. (*b*) 2nd screw, slight slip, 47 μgm. (*c*) 3rd screw, greater slip, 65 μgm. (*d*) 4th screw, extreme care, 17 μgm. (*e*) 2nd screw; distribution of transferred metal within slot; the line is the edge of the film and the bottom of the slot. (*f*) Position of film for autoradiograph shown in *e*

ferred from the driver to the screw head was calculated:

| | | | |
|---|---|---|---|
| 1st screw | 22 μgm. | 3rd screw | 65 μgm. |
| 2nd screw | 47 μgm. | 4th screw | 17 μgm. |

The distribution of the transferred metal was determined using an autoradiographic technique. In this method the radioactive particles were photographed by their own radiation on a sheet of X-ray photographic film placed against the screw head. The screws were placed head downwards on the film and the photographs shown in Fig. 1, *a*–*d*, were obtained. Each photograph shows a grey region caused by weak radiation emanating from transferred metal within the slot of the screw, while several small areas of intense whitening indicating transferred particles along the outer edges of the slots are visible in the photographs of the second and third screws.

A photograph showing the distribution of transferred metal within the slot was obtained by inserting the edge of a sheet of film into the slot of the second screw (see Fig. 1, *e* and *f*). This indicates only a little radiation emanating from the bottom of the slot, but shows several densely whitened areas corresponding to metal adhering to the outer edges of the slot.

Combining the information displayed in Fig. 1, it is possible to estimate that most of the transfer consists of a small number of discrete particles, each having a mass of a few micrograms. Most of the transferred metal is distributed along the outer edges of the slot of the screw (see Fig. 2). If more severe conditions of screwing are used, we may expect the transfer to be correspondingly greater.

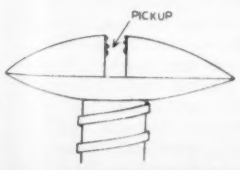


Fig. 2. Diagram of screw head, showing where adherent metal was detected

Some measurements were made of the electrode potential of these steels immersed in $N/10$ sodium chloride and in $N/10$ hydrochloric acid solutions, since this is a major factor in determining inflammation and corrosion. In each solution the steel of the driver was strongly electronegative to that of the screw. This means that under these conditions the two steels could form an electrolytic couple with the driver steel acting as the anode. Samples of the two steels were left in the hydrochloric acid solution for two days. The screw steel showed no apparent corrosion, but the driver steel showed marked chemical attack.

*Surgical observations.* During operations on fractured bones which had previously been fixed with metal plates and screws, portions of the tissues in contact with the metal were removed for microscopic examination. Ten biopsy specimens were obtained. All ten specimens had been in contact with the metal for more than four months and none longer than ten months. No complicating sepsis had occurred in any of these cases. Two microtome sections were prepared from each specimen. One was stained with hæmatoxylin and eosin in order to demonstrate the presence of iron salts in the tissue. These salts are present only when there has been considerable inflammation. The other was stained to detect the presence of smaller quantities of iron in and around the cells by the Prussian blue reaction. The presence of iron in the tissue indicates that corrosion has occurred. It is not in itself very harmful. It is the electrolytic reaction which interferes with the healing of the tissue.

Specimens of tissue removed from areas adjacent to the heads of the screws and bolts showed heavy iron infiltration and tissue inflammation (Fig. 3, *b*). Specimens removed from areas adjacent to metal surfaces which had not been handled heavily showed little iron infiltration or inflammation (Fig. 3, *a*). Over the period studied, the amount of inflammatory change and iron deposit did not depend markedly on the length of time the metal had been buried.

*Conclusion.* The presence of free iron in the tissues adjacent to the stainless steel is taken as evidence of corrosion of the metal. Such corrosion is accompanied by an 'electrolytic inflammation' which interferes with the bone union and healing[4]. Consideration of the surgical material shows that an inert alloy can, on occasion, behave as a toxic one.

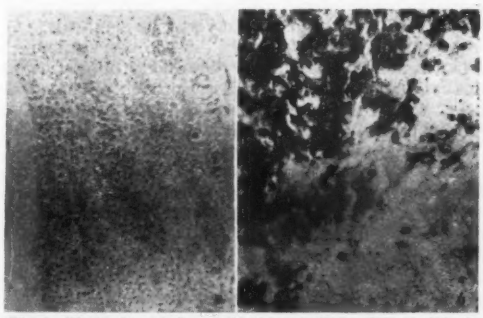

Fig. 3. Photomicrographs of microtome sections of tissue stained to show presence of iron. (*a*) Tissue adjacent to region of stainless steel plate which had not been handled; no iron present. (*b*) Tissue adjacent to region where heavy handling had occurred; heavy deposits of iron

This occurs where the metal has been handled with screwdrivers or spanners, and is apparently more marked when the handling is severe. It is less marked when the metal has not been handled heavily.

The physical experiments show that it is almost impossible to insert a screw without leaving some fragments of metal from the driver adherent to the screw. The amount increases markedly if any slip occurs during screwing. The steel used for the plates and screws is very resistant to corrosion, but that used for the screwdrivers and spanners is not. Measurements show that an appreciable difference in electrode potential can be set up between these two steels, so that they form an electrolytic couple which may have a harmful effect on the healing of the tissue and which will act as a corrosion centre. These physical observations may therefore offer an explanation of the surgical behaviour. Other factors which may play a part are the plastic deformation of the steel and the deformation of the protective oxide layers since these can alter the electrode potential. The effect of differential transfer can be diminished by a suitable selection of the metal used both for the driver and for the screws. We find, for example, that if the screws are made of 'Vitallium' alloy the amount of the driver transferred to it is very much less.

Analogous experiments in bolting operations show that the amount of metal transferred from the spanner to the bolt head is greater than that observed in screwing.

We thank Down Bros. and Mayer and Phelps, Ltd., for gifts of medical tools and screws.

[1] Bowden, F. P., and Tabor, D., "The Friction and Lubrication of Solids" (Oxford Univ. Press, 1950).
[2] Venables, C. S., and Stuck, W. B., *J. Bone and Joint Surgery*, **30A**, 247 (1948).
[3] Fink, Colin G., "Use of Metal in Internal Fixation of Human Bone Fractures". Committee of Medical Research, U.S. Office of Scientific Research and Development (Report No. 17) (1944).
[4] Venables, C. S., and Stuck, W. G., *J. Amer. Med. Assoc.*, iii, 1, 349 (1938).

# OBITUARY

## Prof. E. P. Cathcart, C.B.E., F.R.S.

Edward Provan Cathcart, whose death occurred on February 18, retired in 1947 from the regius chair of physiology in the University of Glasgow after almost half a century of continuous devotion to the study of man as a whole; yet, shortly after he first graduated in medicine in 1900, he went to Germany to study bacteriology. There he came under the influence of Voit, whom he revered as a master. At the beginning of this century direct observations on human beings were largely confined to studies of metabolic processes. Such an approach appealed to Cathcart, and his appointment in 1905 to the newly founded Grieve lectureship in physiological chemistry in his own University gave his predilection full scope. In 1907 he published two classical papers on the metabolism of protein and of inorganic elements during starvation. He used Beauté, a *Hungerkunstler*, as subject. On himself he observed the influence of carbohydrate and of fat on protein metabolism.

Cathcart travelled widely; he studied in Russia with Pavlov, whose influence is shown in the publication of two papers on the gastro-intestinal tract of dogs. Cathcart never took kindly to work on lower animals; more to his liking was his work with Benedict in the United States on energy exchange in man during muscular exercise. Their joint monograph, "Muscular Work", which appeared in 1913, is a classic.

In 1915 Cathcart was appointed to the University chair of physiology in the London Hospital. The First World War was not a period wholly of frustration. He put his special knowledge at the service of the Armed Forces and of the country, and out of this phase arose his abiding interest in nutrition, in human food habits and in the physique of men and women. A monograph on the energy expenditure of the infantry recruit in training was written in collaboration with Lord Boyd Orr and published by H.M. Stationery Office in 1919. Many papers on similar topics appeared in the *Journal of the Royal Army Medical Corps*.

In 1919 Cathcart was invited by his own University to become the first Gardiner professor of physiological chemistry. In 1921 appeared his "Physiology of Protein Metabolism", one of the famous series of "Biochemical Monographs". Cathcart still kept alive his interest in metabolism, paying special attention to the influence of muscular work. With Markowitz he wrote a most acute analysis of the significance of the respiratory quotient, being rather impatient with the oversimplified naïve interpretations then current. However, a shift in the emphasis of his work gradually became apparent. Between 1924 and 1940, the Medical Research Council published five of his reports on the diets of families in different parts of Britain. Membership of the Industrial Fatigue Research Board (later Industrial Health Research Board), of which he was to become chairman during 1933–40, led to work on human physique and stature and to the appearance of two monographs, one on the physique of women in industry (1927) and another on the physique of man in industry (1935).

In 1928 Cathcart succeeded Noël Paton in the regius chair of physiology in the University of Glasgow. In his later years committee work and administration made increasingly heavy demands on his time; his colleagues in the Physiological and Biochemical Societies saw progressively less of his spare dynamic figure. Yet he kept alive his interest in the implications of physiological knowledge for social welfare, he did some little work on psychology, and his last scientific publication in 1948 dealt with histological work on the innervation of the nipple.

Cathcart's work, in spite of its seeming diversity, was all of a piece. His early studies on metabolism, on the alimentary canal and on energy exchange in man led on smoothly to his later work with its wide social implications.

Without being reactionary, Cathcart had yet a sceptical habit of mind. The new and the novel in physiology and in social science had less appeal than the established facts and accepted attitudes of the past. Facts were naturally sacred; but comment, he felt, ought not to be too free in view of our essential ignorance of the functioning of the integrated organism as a whole. Thus Cathcart resisted what he regarded as excessive emphasis on the importance of vitamins and of 'minerals' in nutrition; 'nature' to him was as important, if not more important, than 'nurture'. Yet he was a most stimulating teacher, in his personal relations he was kindly and sympathetic, and he went to endless pains to encourage and to help young workers. It is to be doubted if we shall see again anyone so well versed in the broad principles of human biology.

R. C. Garry

# NEWS and VIEWS

## Physical and Inorganic Chemistry at Bristol: Prof. W. E. Garner, C.B.E., F.R.S.

Prof. W. E. Garner is retiring after twenty-seven years from the Leverhulme chair of physical and inorganic chemistry in the University of Bristol, to which he was appointed in 1926, in succession to the late Prof. J. W. McBain. Prof. Garner's energy and outstanding ability have been devoted to the well-being of the Chemistry Department and research, and to the fostering of collaboration between different departments of the University and between his Department and industry. He created the inter-departmental honours school of biological chemistry in 1950. During the Second World War the resources of the Chemistry Department were marshalled for explosives research, and Prof. Garner whole-heartedly applied himself to national work, becoming temporarily, in 1944, chief superintendent of armaments research at Fort Halstead. His researches have been typically broad. He has made valuable contributions to the study of flames and of explosions in gases and solids. His pioneer work on nucleation and decomposition of azides and hydrates, and on the relations between the physical properties and the chain lengths of aliphatic compounds, is of fundamental importance. Work on the surface chemistry of solids, and on the heat and kinetics of adsorption, developed later into an intensive study of oxide catalysts. He was elected to the Royal Society in 1937, made president of the Faraday Society in 1946 and pro-vice-chancellor of the University of Bristol in 1952. Students and colleagues of Prof. Garner have all been inspired by his enthusiasm and insight, and he has always been approachable by even the most junior. Scrupulous fairness, talent for securing willing co-operation, and his ability to put first the real interests of others, have made his Department a most happy one.

## Prof. D. H. Everett, M.B.E.

Prof. D. H. Everett, professor of chemistry since 1948 at University College, Dundee, in the University of St. Andrews, has been appointed to succeed Prof. W. E. Garner in the Leverhulme chair at Bristol. Prof. Everett received his scientific training in the University of Reading, and his first researches were done there and at Dundee under Prof. W. F. K. Wynne-Jones. In 1939 he went as a Ramsay Fellow to work on reaction kinetics under Mr. R. P. Bell at Balliol College, Oxford, but after a short time joined Sir Cyril Hinshelwood's research team working for the Ministry of Supply. From 1942 until the end of the War he was attached to the War Office and undertook scientific liaison missions to the Middle and Far East. Prof. Everett returned to Oxford as an Imperial Chemical Industries Fellow, and in 1947, after a short period as lecturer in Dundee, was elected to an official fellowship at Exeter College, Oxford. He was appointed to the chair in Dundee in 1948, and during the past six years he has supervised the extension and re-equipping of the Chemistry Department and has established a vigorous research school which is working on the thermodynamics of acid-base equilibria, the electrochemistry of non-aqueous solutions, reaction kinetics, the thermodynamics of adsorption, and the phenomenon of physico-chemical hysteresis. He has also translated and revised Prigogine and Defay's "Chemical Thermodynamics", which is to be published very shortly.

## Geology Division of the Anglo-Iranian Oil Co., Ltd.: Dr. G. M. Lees, F.R.S.

Dr. G. M. Lees has retired from his appointment as chief geologist of the Anglo-Iranian Oil Co., Ltd. He had a distinguished record in the First World War with the Royal Flying Corps, winning the Military Cross and the Distinguished Flying Cross, and later served as an assistant political officer in Southern Kurdistan. He joined the Anglo-Iranian Company in 1921 and his early work lay in south-west Persia and Oman; he was awarded a doctorate of philosophy in the University of Vienna for his researches in Oman. He was appointed chief geologist to the Company in 1930 at the age of thirty-two and thereafter worked in many different parts of the world. It was a period of intensive exploration and development; in all this Dr. Lees played an important part, demonstrating remarkable geological knowledge and a shrewd appreciation of practical problems. It was he, too, who inspired the search for oil in Great Britain which led to the discovery and exploitation of oilfields in Nottinghamshire. In 1943 he was awarded the Bigsby Medal of the Geological Society of London and in 1948 was elected a Fellow of the Royal Society. He was president of the Geological Society in 1951 and 1952. It is noteworthy that in his presidential addresses, delivered with his customary skill in exposition, he was concerned with fundamental concepts in geology, bringing to bear upon them the knowledge and experience gained in many countries. His work has always shown the essential unity of pure and applied science.

## Mr. P. T. Cox, M.B.E., and Mr. N. L. Falcon

Following Dr. Lees's retirement, Mr. P. T. Cox has been appointed chief geologist and exploration manager of the Anglo-Iranian Oil Co., and Mr. N. L. Falcon manager of the Company's geological division. Mr. Cox is a graduate of Canterbury University College, Christchurch, New Zealand, and after a short period on the Geological Survey of that country joined the Anglo-Iranian Oil Co. in 1924. He has worked in many countries, notably Peru, Venezuela, Colombia and the Middle East. He made a special study under Prof. Douvillé in Paris of Foraminifera, so important in oilfield geology. He was associated with Dr. Lees in the search for oil in Great Britain, and joint author with him of a paper on the geological basis of that search. He served with the Royal Engineers during the Second World War and was made M.B.E. He returned to Persia after demobilization and became general manager of the Company's oilfields there in 1948.

Mr. Falcon joined the Anglo-Iranian Oil Co. in 1927 after graduation in the University of Cambridge. He served in Persia until 1936, undertaking extensive geological surveys as well as oilfield development. Later he took part in the exploration drilling programme in Great Britain and became increasingly interested in the applications of air photography to geology. He served in the Intelligence Corps during the Second World War, his duties including the study of air photographs, and he was awarded the United States Bronze Star. Since the War, he has been concerned with a wide range of geological problems in Great Britain, Europe and the Middle East. He is author or joint author of papers on various subjects such as gravity-slip phenomena in Persia and the results of geophysical surveys in England.

## Einstein Award : Dr. R. P. Feynman

The third Einstein Award was made on March 14, the seventy-fifth birthday of Prof. Albert Einstein, to Dr. Richard Phillips Feynman, of the California Institute of Technology. This Award, which was established in 1950 by the Lewis and Rosa Strauss Memorial Fund, consists of a gold medal and fifteen thousand dollars, and the recipient is selected by a committee at the Institute for Advanced Study, Princeton, where Prof. Einstein works. The two previous Awards have been made to Dr. Julian S. Schwinger, of Harvard University, and Dr. Kurt Gödel, of the Institute for Advanced Study. Dr. Feynman, who is a graduate of the Massachusetts Institute of Technology, received his degree of Ph.D. from Princeton University in 1942 and was professor of physics in Cornell University during 1945–48. The main field of his research is quantum mechanics and, particularly, quantum electrodynamics. Both among the results and among the concepts in the latter field, some of the most important work developed during the past decade is due to him. In this respect, his treatment of quantum mechanics by the probability amplitude method, and the development of what is known as the Feynman diagram in accounting for possible particle transformations, are especially noteworthy.

## Textile Institute : Awards

Honorary fellowship of the Textile Institute has been conferred on Prof. S. C. Harland, George Harrison professor of botany in the University of Manchester. Prof. Harland, who is the eleventh recipient of this honour, the highest that the Institute can bestow, is responsible for many notable advances in the volume, quality and stability of cotton crops throughout the world as a result of his work in plant breeding and genetics in the Sudan, the West Indies, Brazil and Peru, as well as in Great Britain. Other awards of the Institute have been made as follows : *Institute Medal*, to Mr. W. Howarth (general manager, Musgrave Spinning Co., Ltd.) and to Dr. C. S. Whewell (reader in textile finishing, University of Leeds) in recognition of distinguished service to the textile industry in general and to the Institute in particular ; *Service Medal* to Mr. J. C. H. Hurd (head of the Textile Department, Leicester College of Technology) for valuable services rendered to the Institute.

## Chemical Technology in Edinburgh : New Chair and Department

Approval of the promotion of ordinances for the foundation of a chair of chemical technology and for the institution of a new degree of bachelor of technological science (B.Sc. Technological) has been given by the University of Edinburgh. This decision, taken after consultation with the Heriot-Watt College, Edinburgh, marks the joint response of the University and the College to the urgent need for an increased supply of trained technologists. Both institutions are already making substantial contributions to the demand for training in applied science, and the proposed extension in what has come to be accepted as the fourth main branch of engineering industry is notably appropriate in view of local and national developments in the chemical industry. The new Department of Chemical Technology will be housed in the Heriot-Watt College, where ample provision for it has been made in the extension of the College premises now under construction. The new professor, although occupying the University chair, will act as head of the new Department in the College. The University has agreed to transfer to the College all the equipment in its Sub-Department of Technical Chemistry. The joint arrangement proposed provides a scheme whereby the requirements for the training of University and College students in this field may be met without duplication of effort. It is proposed to make a joint appeal to the appropriate firms in Scotland and elsewhere for contributions towards the endowment of the chair and for suitable equipment to be used for teaching purposes.

## New Chairs at the University of Nottingham

In commemoration of the long and distinguished services of Lord and Lady Trent, the Boots Pure Drug Co., Ltd., has given to the University of Nottingham the sum of £100,000 for the endowment of two new professorial chairs to be known as the Lord Trent chair of pharmaceutical chemistry and the Lady Trent chair of chemical engineering. The announcement of this generous benefaction was made at a special meeting of the Court at which the University accepted with deep regret the resignation, necessitated by continued ill-health, of Lord Trent from the office of chancellor. Lord Trent became a member of the University College Council in 1923 and was later chairman and president. By the charter of incorporation of the University granted in 1948 he was created chancellor. Until his recent retirement he had been since 1931 chairman of the Boots Pure Drug Co., which in 1949 contributed £50,000 to the University's endowment appeal. The natural interest of the Company in the development of chemistry found its expression so long ago as 1921 when, as Sir Jesse Boot, the first Lord Trent, to whose munificence the University owes its principal buildings at University Park, endowed the Sir Jesse Boot chair of chemistry. In founding a chair of pharmaceutical chemistry the Company has indicated its desire to encourage the study of pharmacy and the development of research. The endowment of a chair of chemical engineering, following the recent institution of the Cripps chairs of metallurgy and of production engineering (*Nature*, December 19, p. 1129), will materially aid the University in its plans for the further development of the technological sciences.

## Year Book of the Royal Society

The recently issued Royal Society "Year Book" (pp. 311 ; from the Royal Society, Burlington House, London, W.1 ; 1954 ; 15*s*.), like its predecessors, is a volume which, apart from its usefulness as a work of reference, is a book to be dipped into for the host of scientific items—some important and some less so, but all interesting enough—which are to be found among its pages. The lists of Fellows and foreign members occupy the first fifty pages and give their appointments, postal addresses, year of election to the Society, awards by the Society and service, if any, on the Council. It is interesting to note from these lists that there are four Fellows who were elected more than fifty years ago. The remaining five-sixths of the book is so full of miscellaneous information regarding the membership of the many types of committee and board, standing orders, procedure for the council, medal awards, lectures, financial trusts and funds, special fellowships and appointments, that even the listing of these items is a lengthy affair. One revealing

point emerges from these pages, namely, the way in which the Society is advised on the various branches of science by means of its sectional committees. These are eight in number and are as follows: mathematics; physics; chemistry; engineering sciences; geology; botany; zoology; and physiology and medical sciences. The first six have nine members each and the last two twelve. It is worth noting that the full title of the Royal Society is the Royal Society of London, for Improving Natural Knowledge. The fact that it exists for improving natural knowledge is a *sine qua non*; the "of London" would seem to-day to be merely significant of the *venue* of its meetings, for the Society is the premier national scientific body, being open to all members of the British Commonwealth and the Republic of Ireland.

## The Piltdown Flints

At a meeting of the Geological Society held at Burlington House on February 24, Mr. A. T. Marston exhibited a number of flints which he had attempted to stain with chromic acid or potassium dichromate in order to assist appreciation of the condition of the Piltdown flint recently described by Drs. Oakley and Weiner (*Nature*, December 12, 1953). Mr. Marston pointed out that though some of these flints would not stain at all, others became deeply stained. In the latter case, however, the stain was very difficult to remove. As the stain on the Piltdown flint had apparently been easily removed by acid, Mr. Marston queried whether it had indeed been artificially produced, and also inquired whether there was any possibility that traces of chromium might exist naturally in the ferruginous Piltdown gravels. Dr. Oakley then exhibited specimens of flint from Piltdown, and described tests that had been made on all the flints illustrated in the original paper by C. Dawson and A. Smith Woodward. All these flints had a ferruginous stain which was easily removed by acid, in contrast to other 'natural' flints from the Piltdown area collected at the same time, which had a heavy ferruginous stain that was not removed by acid. In one of the flints illustrated in the original paper (B.M.(N.H.) *E*. 606), the presence of chromium had also been demonstrated. Dr. Oakley believed that the illustrated flints had been stained artificially with a ferruginous solution, and in one case a chromic solution had also been used in order to make the flint less red, and so resemble more closely the 'natural' flints.

## New Journal of the Medical Faculty of Zagreb

A new and attractively produced journal entitled *Radovi Medicinskog Fakulteta u Zagrebu* (Vol. 1, pp. 146+7 plates; 1953) has been started by the Medical Faculty of Zagreb, under the direction of Prof. F. Kogoj. It contains articles on a variety of subjects, most of which have summaries in English or French. Drs. B. Gušić and Z. Krajina write on otitis of suckling infants, and Dr. B. Milojević on his experience of the treatment of chronic suppurative otitis media by the endaural approach to the middle ear, an operation for which it is claimed that it shortens the period spent in hospital and makes possible direct approach to the middle ear cavity, so that the structures of this part of the ear are preserved and most cases recover their hearing. Drs. Lj. Božović and L. Rabadžija discuss the reactions of the eosinophil blood cells in rats adapted to adrenalin and histamine, and Drs. J. Vesenjak-Zmijanac and V. Beličević report on influenza in Zagreb during 1950–51. Dr. N. Allegretti considers the function of the insular apparatus and insulin in relation to the anterior lobe of the pituitary gland, the thyroid and the adrenal cortex, and Drs. E. Rosenzweig and F. Zerzavy discuss about eighty-eight cases of brow-presentations at birth. An article by Dr. V. Bezjak on the classification of fungi isolated from man in Zagreb is the first report on these organisms in Yugoslavia. The early diagnosis and modern therapy of malignant tumours of the upper jaw and nose is discussed by Drs. B. Pegan and M. Špoljar; Dr. A. Brnobić writes on the etiology of two cases of professional allergic eczema, one caused by silkworm larvæ, and Dr. Z. Jurin-Mratović on the treatment with penicillin of seventeen cases of scleroderma and chronic acrodermatitis. The good wishes of medical men will readily go to this promising new journal. The language difficulty will probably restrict its usefulness in Britain; but the English and French summaries give the gist of the articles, and those who wish to read them in full can probably arrange to have them translated.

## Society for the Bibliography of Natural History

The annual general meeting of the Society for the Bibliography of Natural History was held at the Geological Museum, London, S.W.7, on March 4. Mr. V. A. Eyles addressed the meeting on "Bibliography and the History of Science". The first part of the third volume of the Society's *Journal* was issued at the end of December 1953, containing ten articles, of which one is an appreciation of the late Dr. C. Davies Sherborn, first president of the Society. The following were elected officers of the Society: *President*, Dr. J. Ramsbottom; *Hon. Secretary and Treasurer*, Mr. A. C. Townsend, British Museum (Natural History), London, S.W.7; *Management Committee*, A. G. Davis, W. N. Edwards, F. C. Fraser, F. J. Griffin, W. T. Stearn, C. Kirke Swann.

## Physical Society Exhibition

The Physical Society's thirty-eighth Annual Exhibition of Scientific Instruments and Apparatus will be held in the Imperial College of Science and Technology, South Kensington, London, S.W.7, on the following dates: April 8, 9 and 12, 10 a.m.–8 p.m.; and April 10 and 13, 10 a.m.–5 p.m. The morning of April 8 (10 a.m.–2 p.m.) will be reserved for Fellows of the Society and the press only. This year the Exhibition is confined to the main building of the College, Imperial Institute Road. Three discourses (each at 6.15 p.m.) will be given as follows: April 8, "Electrical Contacts", by Prof. F. Llewellyn Jones; April 9, "An Artificial Talking Device", by Mr. W. Lawrence; and April 12, "The Study of Surface Micro-topography by Optical Methods", by Prof. S. Tolansky. Orders for the usual "Handbook" (6*s*., or 7*s*. 3*d*. by post) and all matters relating to the Exhibition should be addressed to the Physical Society, 1 Lowther Gardens, Prince Consort Road, London, S.W.7.

## Society for Analytical Chemistry

The eightieth annual general meeting of the Society for Analytical Chemistry was held on March 3 in London, when the financial statement and report of the Council for the past year were submitted and approved. The membership of the Society was reported as being 1,646, an increase of 54 since last year. In addition to the eight ordinary meetings of the Society (six in London and one each in Glasgow

and Southampton), eighteen meetings were held by its Sections and Groups during the course of the year. At the conclusion of the meeting, the Bernard Dyer Memorial Lecture of the Society was given by Dr. E. B. Hughes, who spoke on "The Contribution of Public Analysts and Other Analytical Chemists to Public Welfare". The following officers and members of council were elected for the forthcoming year: *President*, D. W. Kent-Jones; *Past Presidents serving on the Council*, Lewis Eynon, G. W. Monier-Williams, J. R. Nicholls and G. Taylor; *Vice-Presidents*, C. A. Adams, A. J. Amos and T. McLachlan; *Honorary Treasurer*, J. Hamence; *Honorary Secretary*, K. A. Williams; *Other Members of Council*, D. C. M. Adamson, A. L. Bacharach, R. C. Chirnside, Miss M. Corner, D. C. Garratt, J. Haslam, C. L. Hinton, H. W. Hodgson, H. M. N. H. Irving, A. G. J. Lipscomb, R. E. Stuckey and C. Whalley; *Ex-Officio Members*, T. W. Lovett (chairman of the North of England Section), R. S. Watson (chairman of the Scottish Section), A. M. Ward (chairman of the Microchemistry Group), A. A. Smales (chairman of the Physical Methods Group) and L. J. Harris (chairman of the Biological Methods Group); *Honorary Assistant Secretary*, N. L. Allport.

## Garth Field Studies Centre

The Garth Memorial Youth Hostel and Field Studies Centre (by Aberfeldy, Perthshire) is situated among fine Scottish mountain scenery and countryside which give excellent opportunities for work in zoology, botany, geology, geography and archæology. Certain rooms in Garth House are occupied by the Scottish Field Studies Association, among which are a library–lecture room and a small laboratory. Accommodation is available for individuals and for parties up to 30–40. This year, the warden (Mr. F. N. Haynes) will conduct two courses on the botany of the area (July 10–17 and 24–31). Further information can be obtained from the Joint Honorary Secretary, Scottish Field Studies Association, Department of Botany, The University, Glasgow, W.2.

## University Visitors to Great Britain

The Association of Universities of the British Commonwealth (5 Gordon Square, London, W.C.1) publishes a list of "Academic Visitors to the United Kingdom", based principally on information furnished by the registrars of member universities and university colleges in overseas parts of the British Commonwealth. Copies are circulated to universities, learned societies and other interested bodies in the United Kingdom with the view of assisting them, if so desiring, to make contact with current or prospective visitors. Copies can be obtained on request. The list, which gives the name, university and post for each entry, is divided into two parts: visitors already in Britain, with approximate date of departure; and non-professorial staff of Colonial institutions spending their long vacation in Britain, with approximate dates.

## Announcements

Sir Alexander Fleming, emeritus professor of bacteriology in the University of London, has been elected a foreign associate of the Paris Academy of Sciences in succession to the late Prof. M. Lugeon. Prof. Léopold Escande, professor of the mechanics of fluids in the University of Toulouse, has been elected a non-resident member of the Academy in succession to the late Prof. E. Bataillon. Prof. Gabriel Foëx, professor of experimental physics in the University of Strasbourg, has been elected *correspondant* for the General Physics Section in succession to Prof. L. Néel, recently elected a non-resident member.

Mr. A. G. Peacock, secretary of the Scientific Instrument Manufacturers' Association, has resigned and joined the board of Mervyn Instruments, St. John's, Woking, Surrey. He is well known as the honorary exhibition secretary of the Physical Society.

Prof. Ragnar Granit, director of the Nobel Institute for Medicine, Stockholm, will give the Silliman Lectures this year, his subject being "Receptors and Sensory Perception". The Lectures, which are open to all those interested in neurophysiology, psychology, psychiatry and related fields, will be given in Yale University on April 29 and 30 and May 3, 4, 5, 6 and 7. They mark the fiftieth anniversary of the first Silliman Lectures on "The Integrative Action of the Nervous System", given in 1904 by the late Sir Charles Sherrington.

Commonwealth Fund fellowships for members of the United Kingdom Home Civil Service to study in the United States during 1954–55 have been awarded to the following: A. Currall (Ministry of Materials), D. W. Davies (Department of Scientific and Industrial Research) and L. E. J. Roberts (Atomic Energy Research Establishment). Similar fellowships for those in the Colonial Civil Service have been awarded to A. L. C. Thorne (Nigeria) and K. J. Henderson (Federation of Malaya).

The Chemical Society is offering a Corday–Morgan Award for 1953, consisting of a silver medal and a monetary prize (150 guineas), which will be made to the British chemist who published during 1953 the most meritorious contribution to experimental chemistry, and who, at the date of publication, had not attained the age of thirty-six years. Applications or recommendations in respect of the Award must be received not later than December 31, 1954. Further information can be obtained from the General Secretary of the Society, Burlington House, London, W.1.

The Colorado School of Mines, Golden, Colorado, is offering a tuition scholarship to a male student from England for the academic year 1954–55. The scholarship, which is renewable for a maximum period of four years, carries exemption from tuition fees (about 425–475 dollars a year) but does not cover student's fee or personal expenses (about 80–110 dollars a month). Further particulars may be obtained from the Cultural Affairs Officer, American Embassy, 41 Grosvenor Square, London, W.1, or from the Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1. Applications must be sent to the latter by May 1.

As part of the Tenth International Congress of Agricultural and Food Industries, to be held in Madrid during May 30–June 6 (see *Nature*, February 20, p. 339), the International Federation of Fruit Juice Producers is holding its third international congress, which will take place during June 1–2. Persons in Great Britain who wish to attend should write to the Apple Juice Producers Association of Great Britain, 8–9 North End, Wisbech, Cambs, from which further information can be obtained.

# DEEP-SEA RESEARCH

SEVEN papers, a foreword and a brief note on a symposium held in the Jane Herdman Geology Laboratories of the University of Liverpool during September 1–2, 1953, constitute the first number of a new scientific quarterly journal, *Deep-Sea Research**, sponsored by the Joint Committee on Oceanography of the International Council of Scientific Unions. All contributions deal essentially with the floor of the oceans, in accordance with the terms of reference of the sponsoring body, namely, "that its work should be restricted to the investigation of the deep-sea floor". The title of the journal tends, therefore, to be misleading, especially if, as seems to be indicated, its policy is to remain focused on deep-sea floor problems and research, the emphasis being mainly geological rather than oceanographical except by contingency. A title such as "Deep-Sea Floor Research" would thus appear more accurately to express the substance and intention of the journal, and would be more likely to attract those, besides oceanographers, to whom its contents would be of greatest concern and interest.

In the first article, on "International Collaboration in Deep-Sea Research", Dr. J. D. H. Wiseman (London), president of the Joint Commission on Oceanography, cites the complexity of the problems to be solved, together with the high cost of equipping and maintaining oceanic research expeditions, as the case for the practical necessity of international collaboration in such work, an essential prerequisite of which are accurate bathymetric charts of the sea-bed. Those produced by the International Hydrographic Bureau, Monaco, and collectively styled "General Bathymetric Chart of the Oceans", are commended provided they can be re-edited every five years. Dr. Wiseman suggests that if these charts were more widely known for their artistic and other qualities, not only among scientific workers, but also to librarians and shipping companies, they would soon become largely self-supporting. The paper further deals with recent scientific developments in deep-sea floor research; for example, the invention by Dr. B. Kullenberg (Sweden) of a new long-core (20 m.) bottom sampler[1], enabling the acquisition of unrivalled material for the study of historic and also prehistoric climatic changes; the evolution by Belgian and Swedish scientists, working in collaboration, of a new method for determining the rate of sedimentation on the sea floor; the rapid improvement in our knowledge of submarine topographical features by the aggregate efforts of a number of American submarine geologists working in conjunction with the United States Navy and Coast and Geodetic surveyors; the accurate measurement of the rate of heat-flow through the deep-sea floor by a co-operative effort of British and American scientific workers; and a number more. Of such promise, indeed, to the Joint Commission on Oceanography is the prospect of realization within a reasonable time of "a new level of understanding of deep-sea problems", consequent upon developments in electronics, physics, chemistry, methods of detailed surveying and sampling of the deep-sea floor; and recognizing the virtual necessity of international collaboration in investigations to that end, Dr. Wiseman gives it as the express intention of the Commission to explore the possibility of establishing a permanent, non-governmental bureau or council to act as an advisory and promoting organization for the conduct of deep-sea floor and contingent investigations. In this, one may be disposed to be sceptical of the necessity to establish yet another body, especially a permanent one, for purposes which perhaps a judicious modification or extension of the terms of reference of existing organizations, national or other, might well and sufficiently include.

A second paper, by Dr. Wiseman and Mr. C. D. Ovey, the secretary of the above-mentioned Joint Commission, usefully sets out a list of approved and defined terms, with a statement of agreed principles to govern nomenclature, which it is proposed should be applied to deep-sea topographical features. Some of the terms, such as 'continental borderland', 'borderland slope', 'seascarp', 'seahigh', 'seamount', 'tablemount', 'seapeak' and 'seaknoll' are new; and the list, which is largely the work of the British National Committee on the Nomenclature of Ocean Bottom Features, set up under the corresponding International Committee of the International Association of Physical Oceanography, is now published in order to test the degree of universal acceptance and employment of the terms before the parent Committee promulgates its decisions. These terms, if universally approved and adopted, would, by the introduction of systematic nomenclature on the lines proposed, obviate much future confusion and ambiguity in the specification of oceanic bathymetric features.

Prof. Hans Pettersson (Sweden), in a third paper, gives a summary account of the origin, aims and principal results of "The Swedish Deep-Sea Expedition, 1947–48", which he was chiefly instrumental in instigating and carrying through to a successful conclusion. The main work of this fifteen-month circumnavigating enterprise on the 1,450-ton motor-schooner *Albatross*, loaned by the shipping firm of Broström and Co., Gothenburg, before being put into service as a training-ship, centred around Kullenberg's long-core bottom sampler operated at great depths, the record depth at which a long core was taken being 7,500 m. Bottom profile records to more than 7,000 m. were also made, revealing that, in these abyssal regions, as in lesser depths, flat areas of practically uniform soundings are the exception rather than the rule. As Prof. Pettersson points out, this new fact raises important questions regarding the dynamics, tectonic and volcanic, of the deep-sea floor, and implies replacement of the former conception of a vast sea-floor peneplain due to age-long uninterrupted sedimentation smoothing out any original ruggedness in the rocky substratum, by that of a constant 'resculpturing' of the ocean bed, producing abrupt differences in level. New techniques, methods and means, some of them devised during, and by members of, the expedition, were employed in the measurement of the thickness of the bottom sediment, in determining bottom water movements in very deep water by study of its optical properties and the prevalence and stratification of suspended particles, and in the taking of undisturbed water samples quite near to the bottom. Large quantities of water were collected and preserved for uranium and radium measurements, and trawling operations were carried out at great depths in the North Atlantic Ocean to study the abyssal fauna. It is hoped that

* *Deep-Sea Research*, 1, No. 1; October 1953. Pp. 64. (Published quarterly by the Pergamon Press, Ltd., 242 Marylebone Road, London, N.W.1.) £4 4*s*. a vol. or 24*s*. a number.

at least the essential scientific results of the expedition, some of which have already appeared, will be published before the end of 1956.

The next paper is a contribution by B. C. Heezen, M. Ewing and E. T. Miller, of the Lamont Geological Observatory of Columbia University, New York, and deals with a "Trans-Atlantic Profile of Total Magnetic Intensity and Topography, from Dakar to Barbados". Early flights over marine areas with an airborne magnetometer indicated that correlation might exist between topographical features and the character of the magnetic field. By enclosing this instrument in a non-magnetic, streamlined, waterproof case, and towing it behind a ship, magnetic surveys of oceanic areas have become possible without the use of specially constructed, non-magnetic vessels, and the above authors give an account of such a survey across the Atlantic in 1948, when west of Dakar for 170 miles the magnetic field was found to be smooth with anomalies of less than 25 gammas. Anomalies of 50 to more than 200 gammas, 5–40 nautical miles in width, were encountered from the Cape Verde Islands region to Barbados. The topographical contrast between the deep ocean basins and the Mid-Atlantic Ridge was not reflected in the anomaly curve, while large anomalies observed over the submerged parts of the Cape Verde Islands showed the effect of known volcanic islands. No such anomaly was observed near Barbados, or over the continental margin of Africa.

A paper follows by F. Bernard on the role of calcareous flagellates in deep-sea fertility and sedimentation, as shown by recent work in the Atlantic Ocean and in the Western Mediterranean. Coccolithophorids were found to be the chief subscribers to sedimentation to depths of at least 4,000 m., the total volume of calcareous flagellates generally amounting to more than 50 per cent, and often 95 per cent, of the phytoplankton in the bathypelagic zone.

Dr. Wiseman and N. Hendry, from a unique bottom sample collected by H.M.S. *Challenger* in 1951, write on the significance and diatom content of a deep-sea floor sample from the neighbourhood of the greatest oceanic depth. The sample was from a depth of about 10,505 m. at a position about five miles from the greatest known oceanic depth in the Marianas Trench[2] and was taken by means of a Baillie rod. The position was about 60 nautical miles west of that at which, during her classical voyage of 1872–76, the former H.M.S. *Challenger* took a similar sample in about 8,185 m. The two samples were similar in colour and of proportionately the same amounts of organically produced silica, but differed in the proportions of the organisms present, the earlier material being almost entirely composed of radiolarians with few diatom fragments, while approximately 4 per cent of the recent sample consisted essentially of diatoms with minor amounts of radiolaria. There was clear evidence of erosion, the authors state, in electron microscope photographs of the 1951 sample. In conclusion of this article, the geomorphological relations and some of the problems of deep-sea trenches are discussed.

The concluding article to this interesting number of the new journal is one giving further notes on the greatest oceanic sounding and the topography of the Marianas Trench, by Dr. T. F. Gaskell, J. C. Swallow and Commander G. S. Ritchie. J. B. Tait

[1] See *Nature*, 145, 306 (1940).
[2] See *Nature*, 169, 601 (1952).

# THE TRAVELLING SCHOLAR IN EUROPE

## BRITISH COUNCIL ACTIVITIES

THE report which the British Council has issued*, with a foreword by Sir David Hughes Parry, on a co-operative experiment in academic interchange between the universities of the United Kingdom and those of certain other European countries is a fitting complement, alike to the recent report on the Fulbright Programme (see *Nature*, 173, 1; 1954) and to the discussions on academic interchange within the British Commonwealth at the Congress of Universities of the British Commonwealth last July. The experiment began as the product of a cultural convention in 1946 between the Governments of the United Kingdom and of Belgium, and the British Council was designated as the principal agent of the British Government in the joint administration of the mixed commissions established to further the aims of this and similar conventions concluded between the United Kingdom and seven other European countries. The British Council entrusted its responsibility for carrying out recommendations regarding university interchange to its Universities Advisory Committee, with Sir James Mountford as chairman; but in 1950 a special standing committee, under the chairmanship of Sir David Hughes Parry, the vice-chancellor of the University of London, was constituted to deal with proposals for foreign university interchange.

As a result of discussions with representatives of universities and education authorities in seven European countries, it became clear that there was a widespread demand throughout Europe for the re-establishment and increase of academic contacts with the United Kingdom, and that two main types of visit were required: the short visit of a few days to a week to enable scholar to meet scholar for the exchange of ideas, to give one or two formal lectures or to participate in colloquia; and the longer teaching visit of up to a term in length. More recently, Belgium has voiced a desire for the interchange for short periods of younger university scientists who have not yet achieved an international reputation. Concentrating first on the short visit by teachers of established reputation, an agreed Foreign University Interchange Scheme with Belgium came into operation in 1948. This was followed by similar arrangements with the Netherlands and Norway in 1949; with France and Austria in 1950; with Western Germany, Italy, Spain, Sweden and Switzerland in 1951; and with Finland and Portugal in 1952; arrangements were also concluded with Yugoslavia for an interchange scheme to commence in the academic session 1953–54. In all, the Scheme provides for a total of fifty-four visits to United Kingdom universities from thirteen countries each session, and for a like number of visits by British university teachers to universities in these countries.

Since the first Scheme came into operation in 1948, 252 such visits have taken place between universities in the United Kingdom and in the other participating countries. While the principles of procedure vary

* University Interchange Between the United Kingdom and Other European Countries. 1948–1953. (A Report on Reciprocal Schemes which are in Operation Between the United Kingdom and Other Countries in Europe, for the Promotion of Interchange Visits by University Teachers, and for the Award of Scholarships.) Pp. 24. (London: The British Council, 1953.)

slightly from one country to another, it has been proved that academic interchange can be organized centrally without undue threats to university autonomy and with economy in the administrative organization necessary. It is also clear that the short-period interchange visit meets a real need: no fewer than two hundred nominations are now received each year from United Kingdom universities for the incoming visits, and the number of invitations extended to British scholars by foreign universities leaves no doubt that the value of such visits is recognized just as fully by the other participating countries. Although some universities have independent schemes of their own which contribute to the total of interchange visits, it can be said that the Foreign University Interchange Scheme plays a substantial part in the renewal and furthering of academic contacts, with all that such contacts imply for international understanding and the advancement of knowledge.

Limited experiments have also been made in the provision of longer teaching visits. There are now four travelling lecturers attached to the French Institute in London who give regular courses at universities in the United Kingdom, and the British Council has to some extent met requests from abroad for similar teaching visits by British lecturers. Eight teaching visits for a month or more have been paid by British university teachers to universities in Austria, Finland and France. While the value of the longer teaching visit has been amply demonstrated, the reduction of the British Council's grant-in-aid has necessitated the termination of such visits for the time being.

On a different level, the interchange of students for postgraduate study has also become well established as a two-way traffic. For a number of years the British Council has offered scholarships tenable in the United Kingdom to students from other countries throughout the world. During the five academic sessions under review, 410 awards have been made, mostly for postgraduate study at a university for one year, to students from European countries with which reciprocal scholarship schemes are in operation. In reciprocation, foreign governments and universities are now offering annually for postgraduate study in fifteen European countries more than a hundred such awards to British students, mostly for one year; and the British Council has been asked by these governments and universities to assist in the administration of the scholarships, and usually to arrange with the Universities Advisory Committee for convening selection boards to recommend suitable candidates. The large number of applications received indicates that the facilities are fully appreciated on both sides.

There are also certain direct exchange arrangements between universities in the United Kingdom and in other European countries, and scholarships and fellowships offered by individual universities add to the total volume of student interchange. While the immediate results of interchange at this level may be less apparent than with interchange at the teaching level, the first-hand experience gained provides a valuable cultural link between the United Kingdom and other countries. On the evidence of this report alone, reductions in the British Council's grant-in-aid, which compel the interruption of such interchange at all levels, are scarcely sound economy.

There is a further reason why the Government should take care to ensure that the British Council has sufficient financial resources to further interchange schemes on a reasonable scale. In December 1953, the Committee of Ministers of the Council of Europe signed in Paris five conventions, the most important of which will materially help young people from any of the sixteen member States in seeking admission to the universities of any of the others. The Convention commits the governments to the acceptance of international standards, but gives no guarantee of admission to a university, although the foreign student may be spared some troublesome examination when making application for admission.

The treaty powers are required to report progress in a year's time. No British Government either could or would attempt to dictate to the universities regarding the conditions or qualifications which the universities accept for admission, though British universities have been very unwilling to promise acceptance of equivalent qualifications of studies from outside the Commonwealth and the United States. Exceptions are in practice frequently granted, but both foreign students and officials are often perplexed by the apparent anarchy of regulations and variations from one university to another through which the wandering scholar has seldom shown much skill in finding his way. While the Government may well, particularly in view of the discussions at the Universities' Congress in July, expect the universities to give proof that they can really unite to make things easier for the individual student or scholar—who after all is nearer the wandering scholar or student of the Middle Ages than those whose movements are formally organized in interchange schemes—the Government must at least set the example of seeing that no short-sighted parsimony curtails what is already being done so admirably by the British Council and other bodies.

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## THE NATURE CONSERVANCY

AN article surveying the first two reports of the Nature Conservancy*, covering the work of the Conservancy for the period up to September 30, 1952, and for the year ended September 30, 1953, appears on p. 516 of this issue of *Nature*. Apart from their special scientific interest, they are of general interest as contributing to that wide understanding of the nature and importance of the work of the Conservancy which the Huxley Committee recognized as essential to the success of any system of nature reserves. Although the Nature Conservancy was constituted by Royal Charter "to provide scientific advice on the conservation and control of the natural flora and fauna of Great Britain; to establish, maintain and manage nature reserves in Great Britain, including the maintenance of physical features of scientific interest; and to organize and develop the scientific services related thereto", the management (and still more the designation) of nature reserves demands a large amount of local co-operation and support. Even on the scientific side, the Conservancy recognizes that the full achievement of some of its essential tasks, such as a continuing thorough biological survey of the British Isles, requires a good deal of co-operation

* The Nature Conservancy. Report of the Nature Conservancy for the period up to 30th September 1952. Pp. iii+33. 1*s.* 3*d.* net. Report of the Nature Conservancy for the year ended 30th September, 1953. Pp. iii+31. 1*s.* 3*d.* net. (London: H.M. Stationery Office, 1953.)

from individual naturalists and various specialized societies, and it is the Conservancy's duty to encourage and, where possible, extend this voluntary effort.

In the establishment of reserves in Great Britain, the Conservancy has obviously encountered some of the same difficulties as the National Parks Commission, and in its present judgment a considerable acceleration of the acquisition and declaration of new national nature reserves is essential in order to prevent the loss of sites of irreparable importance. This has proved a far more complex and difficult undertaking than was at one time supposed. Increasing pressure and mobility of population, and changing economic, technical and defence requirements are simultaneously reducing the available choice of surviving semi-natural habitats and are greatly increasing the difficulty of safeguarding them against competing claims, disturbance or deterioration. At September 30, 1952, nine nature reserves had been declared—two in Scotland and seven in England: a year later the total was only eleven, some of which represented parts only of the proposed eventual reserve areas, though the Kingley Vale and Ham Street reserves were substantially increased during the year. Negotiations over a number of other reserves had, however, led to agreement, although for some reason or other formal declaration during the year was not possible, and a much larger total of declarations during the coming year is anticipated. Special reference is made to Roudsea Wood, Westmorland, which, under a nature reserve agreement, will be used as a study and experimental area for the neighbouring Merlewood Research Station and to the Cairngorms. Approaches from the Scottish Committee of the Conservancy to landowners concerned regarding the establishment of a national nature reserve in the Cairngorms without prejudice to the climbing public and to the ultimate formation of a national park, in accordance with a resolution passed at a meeting in Inverness in January 1953, met with sympathetic response. By the end of September there was reasonable ground for hoping that any remaining points of difference might be cleared away and this group of mountains permanently safeguarded as a nature reserve.

The National Parks Act also empowers local authorities, in consultation with the Conservancy, to set up reserves, and although there are difficulties, particularly financial and in the provision of skilled biological management, the progress made indicates the existence of an encouraging amount of local understanding and support for the Conservancy's work. The first local authority to establish a nature reserve in its area was the Lincoln (Parts of Lindsey) County Council, which on August 1, 1952, made the requisite declaration of an area of some 300 acres of sand dune and salt marsh facing the Wash at Gibraltar Point. The East Lothian County Council has proceeded similarly with the declaration of Aberlady Bay, while in June 1953 a declaration by the Skegness Urban District Council in respect of that part of the Gibraltar Point range of dunes within its ownership and its boundaries brought the original area to 500 acres, all to be managed by the Lincolnshire Naturalists' Trust, Ltd. The Conservancy has also been consulted by the Cumberland County Council about the sand-dunes opposite Ravenglass, where there is an important gullery and ternery. Not only was great local interest shown in the complex relation between the bird colonies and the neighbouring human communities, but also all parties were agreed on the importance of preserving the bird colony as an inheritance to be handed down to future generations.

During the past year, the National Trust has arranged for the Nature Conservancy to manage five properties of natural history interest. These are Llyn Idwal, on the Penrhyn estate; Blelham Bog and North Fen, Esthwaite, in the Lake District; Scolt Head Island; and the Ruskin Reserve near Abingdon. There will be public access. The Conservancy has made temporary grants to the Royal Society for the Protection of Birds Reserve at Dungeness and to the Norfolk Naturalists' Trust Reserve at Hickling Broad for the employment of watchers or maintenance staff with the view of bringing back these reserves into first-class condition. While the most satisfactory division of responsibility and of labour between the various interested bodies has still to be worked out, the Conservancy has been much encouraged by the constructive and co-operative attitude which is so evident.

One reason for welcoming these reports and for giving them wide publicity is that they should help to remove the misunderstandings as to public access which have impeded negotiations, though probably to a lesser extent than in those leading to designation of national parks. Neither the designation of a park nor the declaration of a reserve confers any rights of public access, and the Act excludes declared nature reserves from its provisions for making access agreements in respect of what is defined in the Act as 'open country'. This does not mean that access to reserves will be generally denied. The Conservancy's policy is to allow as much access as is compatible with the proper scientific management of particular reserves. In those being used for experimental work, access must be carefully controlled; in some places access by permit, subject to compliance with stated conditions and to reasonable limitations of numbers, will be available to those generally interested. In other reserves the Conservancy hopes that the public will, by their behaviour, enable a policy of unrestricted access to be maintained.

A clear statement of the Conservancy's policy and the reasons governing the issue of permits to visit nature reserves which cannot be generally open to public access is appended to the report for the year ended September 30, 1953, and its wide circulation should both remove misunderstandings and encourage the local and general co-operation so helpful to the success of the Conservancy's work. Moreover, there is much material in these reports which demonstrates the importance of the scientific work of the Conservancy to the national economy. Now that its research stations at Merlewood, Morecambe Bay and at Furzebrook, Poole Harbour and its field stations (Anancaun on Loch Maree and Moor House, Westmorland) are equipped and at work, and the initial reconnaissance and listing of sites of scientific importance is virtually finished in England (although much remains to be done in Scotland and Wales), it is to be hoped that the Conservancy will not be too preoccupied with its research programme to neglect this important task of education and interpretation. Exposition at the appropriate moment of the significance of the results obtained in some of its scientific work, such as that on coastal erosion or the effects of spraying hedgerows and road-side verges with herbicides, or its studies on the ecology of the rabbit or of the introduction of reindeer in Scotland, could foster public understanding and goodwill, and thus help to ensure both that the modest sums required by

the Conservancy are provided by Parliament and that public access to the reserves causes neither abuse nor friction. It is satisfactory to note that in the latest report due stress is laid upon the development of the educational, information and intelligence aspects of the Conservancy's work and the preparation of suitable publications.

## SICKNESS IN ENGLAND AND WALES

A RECENTLY published report from the Registrar General* describes three attempts to obtain statistics of morbidity, as distinct from mortality, in England and Wales. The study of mortality statistics was one of the main instruments of preventive medicine during the past hundred years. The statistics are extensive, detailed and complete. In their present form they represent the result of attempts to obtain information about human populations and not merely a by-product of administrative activity. By contrast, most existing statistics of morbidity are fragmentary and unsatisfactory, though they are of even greater potential interest than the mortality statistics. Most of the existing morbidity statistics, such as those derived from the records of Friendly Societies or hospitals, are incomplete in their coverage of the population; and most of them illustrate the limited value, for studies of general problems, of statistics originally collected for highly specialized purposes.

The three studies in the report under notice illustrate these general points, the first study being an account of the Survey of Sickness for the years 1948 and 1949. This Survey, using a designed sample, attempted to obtain information about sickness, duration of incapacity and frequency of medical consultation among the whole population. In principle, its results (here tabulated by age, sex and income of the persons interviewed) are of great importance in connexion with the operation of the National Health Service. In practice, the information obtained lacks precision, particularly as to the nature of the diseases causing incapacity. At best, the Survey provided information about what people thought was the matter with them. There is internal evidence, also, of the operation of memory effects. Nevertheless, the results of the Survey are interesting in themselves and will be even more interesting when they can be correlated with relevant statistics from other sources. Among these may be mentioned the results of an inquiry into hospital in-patient records conducted by the Registrar General, and the results of an analysis of claims to sickness benefit under the National Insurance Acts conducted by the Ministry of National Insurance. These results are apparently to be published in due course. In the meantime, it seems unfortunate that the Sickness Survey was abandoned in the interests of financial economy in 1952. Whatever the faults of this particular Survey may have been, investigations on similar lines offer the only means of obtaining morbidity statistics covering the whole population.

The second of the three studies illustrates another source of morbidity statistics, namely, records of admissions to hospital. The study is devoted to statistics of mental disorders derived from the records of mental hospitals under the National Health Service. The results are interesting in themselves, but also serve to show the limitations of this source of information. The form designed for this inquiry proved too complicated to be satisfactorily completed by the hospitals. This is the converse of the usual situation in which the hospital administration produces records insufficiently detailed and standardized for the purposes of social medicine. The third study describes some of the results of the Cancer Registration Scheme relating to 1947 and 1948. Statistics for 1945 and 1946 have already been published elsewhere. This is an interim study describing an early phase of the construction of a complete statistical picture of this group of diseases. At present it covers only part of the population (that served by the hospitals taking part in the Scheme), but it achieves a high degree of diagnostic accuracy. It will in the end, no doubt, combine both accuracy and completeness. At present the tables give information about numbers of cases by age and sex and about the delay between first symptoms and starting of treatment for cancer of various sites.

* The Registrar General's Statistical Review of England and Wales for the year 1949: Supplement on General Morbidity, Cancer and Mental Health. Pp. ix+186. (London: H.M.S.O., 1953.) 7s. 6d. net.

## EARTHQUAKES DURING 1953

THE five earthquakes which did most damage during 1953 occurred on February 12 (magnitude 7) in Persia; on March 18 (magnitude 7¾) in Turkey; during August a swarm (greatest on August 12, of magnitude 7¼) near Cephalonia; on September 10 (magnitude 6½) near Cyprus; and on December 12 (magnitude 7¾) in Peru. In addition, nineteen other earthquakes were of magnitude 7 or more, the greatest being on November 25 (magnitude 8¼) near Japan.

Fourteen earthquakes had foci at depths of 200 km. or greater, the deepest occurring on April 14 (magnitude 7) in western Brazil and on November 4 off Korea, both having a depth of focus of 650 km.

The Persian earthquake in February occurred in the Province of Khorasan and devastated Shahrood, Torroud and neighbouring villages, killing hundreds of the inhabitants when their houses collapsed on them.

The Turkish earthquake of March 18 occurred south-east of the Dardanelles in the region of Chanak, Balikeser, Yenice and Gonen, where more than a quarter of a million pounds sterling damage was done and hundreds of people were killed by falling debris and the fires which followed the earthquake.

The swarm of earthquakes in the Greek Ionian islands of Cephalonia, Ithaca and Zante culminated in the shock of magnitude 7¼ on August 12 and caused great damage, there being 394 deaths and a further 941 casualties (see *Nature*, August 22, p. 332). Argostoli, Lixouri and Zakynthos were particularly affected, and just after the earthquakes more than seventy-five thousand people were homeless. The International Seismological Association at Strasbourg reports that some 338 individual shocks occurred in the swarm of August 9–31.

The earthquake which did damage in the Paphos district of Cyprus on September 10 had a smaller magnitude than the others mentioned; but in the town of Ktima and the surrounding villages, including Stroumbi, Kithasi and Ayios Nikolaos, and even as

far as Limassol, much damage was caused; forty people were killed, a hundred injured, and just after the earthquake some four thousand were homeless.

From the reports from sixty-one observatories throughout the world, the epicentre of the earthquake of December 12 has been calculated by E. Peterschmitt and L. Behe at Strasbourg to be at lat. 3·7° S., long. 80·7 W., which is near the coast of Peru. Several people were killed as a result of this earthquake, and there was heavy property damage at Tumbes, Corrales and in the surrounding district.

Reports were received during the year directly from individual stations at Aberdeen, Arkansas, Belgrade, Cleveland (Ohio), Durham, Fayetteville, Karlsruhe, Kew, Lisbon, Lwiro (Belgian Congo), Pasadena, Perth (Western Australia), Toledo and Uccle; from collecting stations at De Bilt, Stuttgart, Wellington (New Zealand) and Zurich; and also from the International Seismological Association at Strasbourg and the United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association, where observations are collected and preliminary epicentres determined.

Ernest Tillotson

# RADIO EVIDENCE OF THE EJECTION OF VERY FAST PARTICLES FROM THE SUN

By J. P. Wild, J. A. Roberts and J. D. Murray

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THE method of studying movements in the solar atmosphere by observing the spectrum of high-intensity radio noise from the sun has been discussed in previous communications[1,2]. It depends on the simple hypothesis that when the spectrum shows an abrupt low-frequency cut-off, the frequency of this cut-off can be identified with the critical escape-frequency at the source, and hence used for determining the height of the source in the solar atmosphere. The hypothesis has previously been applied to the outbursts of long duration for which the characteristic slow drift of the cut-off frequency can be explained in terms of disturbances which move outwards through the solar atmosphere at velocities[1] of the order of 500 km./sec. This result was confirmed in general terms by the directional observations of Payne-Scott and Little[3]. More recently, the critical-frequency hypothesis has been further substantiated by evidence that the observed cut-off must be attributed not to the natural profile of the emitted spectrum, but rather to severe attenuation of the lower frequencies in their escape from the sun[3]. This evidence was obtained by comparing profiles of the fundamental and the second harmonic (which is presumably unattenuated).

In the present communication we offer similar evidence for the application of the same hypothesis to another, more common, type of burst in which the frequency drift is much faster. Thence we infer the existence in the solar atmosphere of corpuscular ejections which move outwards at about one-fifth the velocity of light.

## Type III Bursts

Using the previous nomenclature[4], we shall refer to the two spectral classes mentioned above as type II (slow drift, duration 5–10 min.) and type III (fast drift, duration 5–10 sec.) respectively. In the course of observations between August 1952 and August 1953 with a wide-band (40–240 Mc./s.) spectroscope, it was found that nearly all bursts, excluding those in noise storms, belonged to one of these two classes. In all, four outbursts of type II were recorded and several hundred bursts of type III. The latter

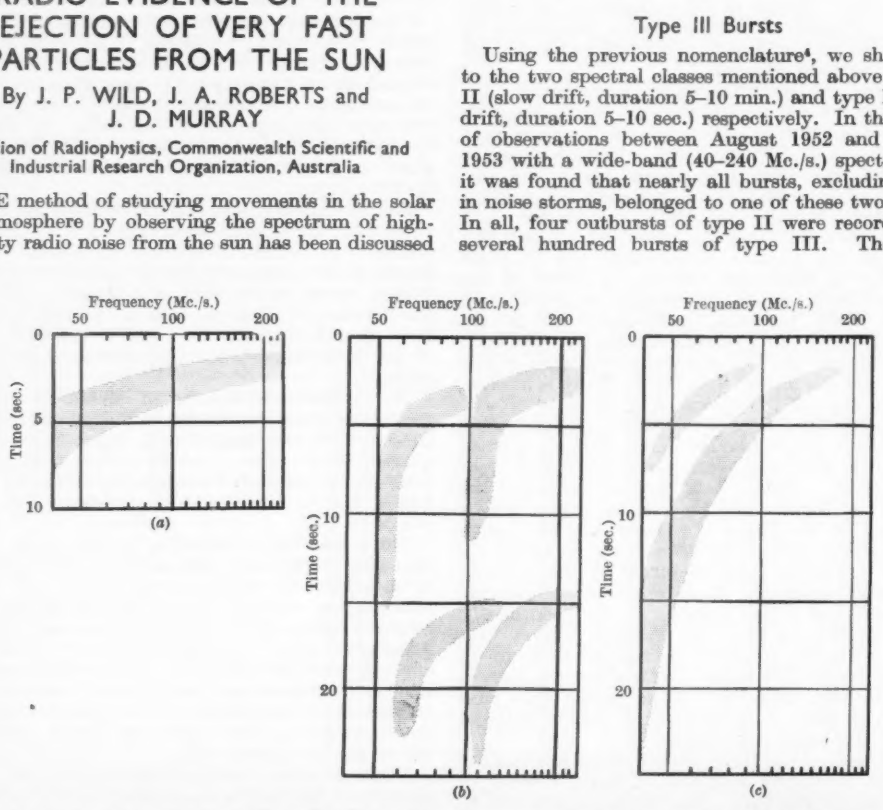


Fig. 1. Dynamic spectra of type III bursts. The shaded areas represent regions of high intensity in the frequency-time plane. (*a*) April 2, 1953, 0447 U.T. (*b*) Harmonic pairs, Jan. 14, 1953, 0607 U.T. (*c*) Harmonic pair, June 5, 1953, 0135 U.T.

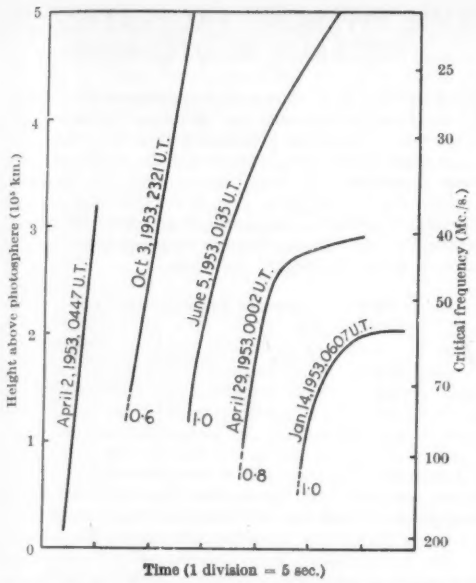


Fig. 2. Plot of derived motions in the solar atmosphere for a selection of type III bursts. The numbers on the curves give the approximate initial velocity in units of $10^5$ km./sec. The first, third and fifth correspond to Figs. 1 *a*, *c* and *b*, respectively

occurred sometimes in isolation but more commonly in small groups. On a few occasions we observed an intense compact *cluster* of type III bursts producing high-level radiation almost continuously for a period of 1–2 min. We have evidence that such clusters sometimes occur at the time of solar flares.

The dynamic spectrum of a simple type III burst, of the kind described previously[5], is shown in Fig. 1 *a*. The spectrum extends over the entire range, the rate of frequency-drift decreasing steadily with time. But the greater frequency-range of the present apparatus has revealed new features in type III spectra. First, the rate of drift is often observed to decrease so rapidly at the lower frequencies that the emitted peak becomes almost 'stopped' at a fixed frequency (see Fig. 1 *b*). Secondly, it is common to find bursts occurring in *harmonic pairs*, in which spectral features of a burst are duplicated at double the frequency (see Figs. 1 *b* and *c*). Just as in the case of type II bursts, comparison of the profiles of fundamental and second harmonic normally indicates that the low-frequency skirt of the fundamental has been cut off during escape. It is this result that justifies the application of the critical-frequency hypothesis to type III bursts.

Two explanations based on this hypothesis have been suggested to account for the systematic frequency-drift of type III bursts[6]. In one, the drift is attributed to the motion of a disturbance which travels outward through the solar atmosphere, thus passing through regions of steadily diminishing electron density. In the other, it is attributed to the rapid dispersion of a stationary, dense cloud situated in the outer corona. The latter interpretation now seems untenable because, with any reasonable distribution of electron-density in the cloud, the predicted band-width would be much broader than that observed in many of the bursts (for example, Fig. 1 *c*). In what follows we adopt the former interpretation and show that it accounts naturally for the known properties of the bursts. On current evidence the case in favour of this interpretation seems strong in view of the very reasonable physical picture which it yields and the simplicity with which it explains the more complicated disturbances ('compound bursts') discussed below.

The derived movements associated with a representative selection of type III bursts are shown in Fig. 2 as a plot of coronal height against time. In this diagram the critical-frequency levels have been calculated from the Allen–Baumbach model and the observed range of levels has been extended by using second harmonics. The initial velocities lie in the range $3 \times 10^4$–$10^5$ km./sec. (0·1 *c*.–0·3 *c*.). Although in some cases the velocity remains almost constant throughout the observed range of heights, none has yet been found with outward acceleration. However, deceleration is common, and in cases such as Fig. 1 *b* (corresponding to the last curve of Fig. 2), the disturbance is apparently brought to rest at some height within the observed range. In some bursts there is evidence of considerable spread in velocity, whereas in others the narrow band-width means that the spread could be no greater than about 20 per cent of the mean velocity.

The moving disturbances may be explained as corpuscular streams, since at such high velocities protons and electrons would pass through the corona almost unimpeded by collisions. We may note that the emission of very fast particles at the time of solar flares is consistent with a known terrestrial phenomenon. At a velocity of $5 \times 10^4$ km./sec., particles reaching the earth would do so 50 min. after the onset of the flare. This is typical of delays observed between solar flares and the increases in cosmic-ray intensity that occasionally accompany

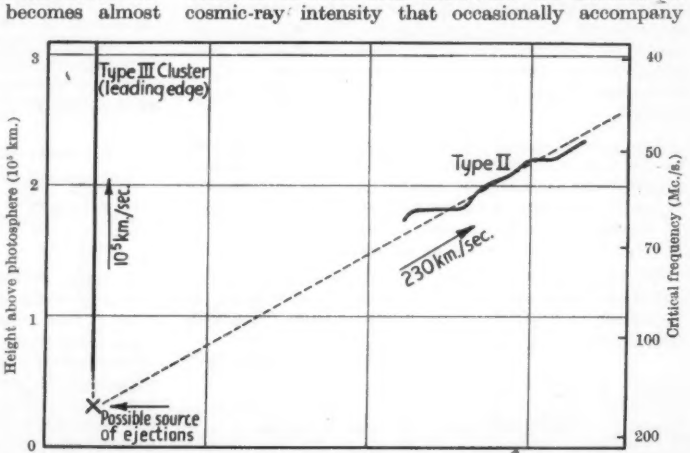


Fig. 3. Plot of the derived motions in the solar atmosphere for a compound burst (Sept. 1, 1952, 0336 U.T.)

them[6]. It is possible, therefore, that type III bursts are caused by cosmic rays of solar origin. However, it should be remarked that unless the particles are much heavier than protons, their energies at velocities of the order of $5 \times 10^4$ km./sec. must be considerably lower than those deduced by cosmic-ray investigators. Nevertheless, the 'low' velocities seem to offer the only simple explanation of the long time delays.

### Compound Bursts

We now know that two kinds of activity may occur at the time of solar flares: the type II outbursts and the type III clusters. During the year, we have recorded four of the former and ten of the latter. Either kind may occur without the other, but on three occasions we have observed the combination of the two. On each occasion the type II burst followed the type III cluster after a time delay of several minutes.

An example is shown in Fig. 3, plotted in terms of heights in the solar atmosphere. The calculated velocities are 230 km./sec. for the type II burst and $1{\cdot}0 \times 10^5$ km./sec for the type III. Both the velocity and the time delay of the type II differ considerably for the three cases observed. Yet in each case extension of the velocity lines towards the origin yields a point of intersection in the lower corona within $10^6$ km. of the photosphere. This suggests that the two portions of the compound burst are associated with disturbances, perhaps streams of matter, ejected simultaneously from a common source located low in the solar atmosphere. Such an 'explosion' may well be the primary cause of the flare.

Speculation on the physical nature of this phenomenon has led us to consider several possible mechanisms.

(1) An explosion involving thermo-nuclear or chain reactions between nuclei of light elements, the products being emitted with characteristic velocities. Such explosions do not seem feasible at the low densities believed to exist in the solar atmosphere, but it is not known whether they may occur slightly below the photosphere.

(2) A sudden accelerating process involving large-scale electric and magnetic fields. The two velocities could result from the acceleration of charged particles of very different mass in the same field. However, the large velocity ratio may be difficult to explain.

(3) A disturbance of some kind which gives rise to the combination of a fast corpuscular ejection and a shock wave. It is noteworthy that the typical slow (type II) velocity is of the order of the mean speed of thermal protons in the corona, which may be identified with the velocity of sound.

We wish to thank Mr. W. C. Rowe and Mr. J. Joisce for assistance in the observational phase of this work, and also Prof. E. E. Salpeter for a valuable discussion on nuclear reactions in the sun.

[Dec. 14.

[1] Wild, J. P., *Aust. J. Sci. Res.*, A, **3**, 399 (1950).
[2] Wild, J. P., Murray, J. D., and Rowe, W. C., *Nature*, **172**, 533 (1953).
[3] Payne-Scott, Ruby, and Little, A. G., *Aust. J. Sci. Res.*, A, **5**, 32 (1952).
[4] Wild, J. P., and McCready, L. L., *Aust. J. Sci. Res.*, A, **3**, 387 (1950).
[5] Wild, J. P., *Aust. J. Sci. Res.*, A, **3**, 541 (1950).
[6] Forbush, S. E., Stinchcomb, T. B. and Schein, M., *Phys. Rev.*, **79**, 501 (1950).

## SOME PHYSICAL PROPERTIES OF METALLIC PLUTONIUM

FOLLOWING a recent declassification decision,[1] it is now permissible to disclose some of the properties of metallic plutonium (Pu, $Z = 94$).

Between room temperature and its melting point, pure plutonium was found to exist in five allotropic modifications, labelled α, β, γ, δ, ε. The temperatures at which the phase changes occur are given in Table 1, determined by dilatometry at heating- and cooling-rates of about 1½ deg. C. per min.

Table 1. Transition Temperatures (°C.)

| | Heating | Cooling |
|---|---|---|
| α ⇄ β | 136 | 85 |
| β ⇄ γ | 225 | About 160 |
| γ ⇄ δ | 320 | ,, 250 |
| δ ⇄ ε | 480 | ,, 480 |

During cooling, the ε ⇄ δ change occurs with little or no temperature hysteresis; but the remaining transformations show considerable sluggishness, which makes it difficult to quote temperatures for the start of the δ → γ and γ → β changes. The β → α transformation commences sharply at 85° C., and continues slowly at room temperature.

The density of α-plutonium at room temperature has been determined by the measurement and weighing of pressed geometrical shapes, and by displacement. The approximate densities of the other phases have been found from dilatometer measurements. Typical figures are given in Table 2: the values for the β, γ, δ and ε phases refer to the low-temperature end of the stable range of the phase.

Table 2. Densities of Phases of Plutonium (gm./c.c)

| α | β | γ | δ | ε |
|---|---|---|---|---|
| 19·0 | 17·4 | 16·6 | 15·4 | 16·4 |

Features of interest in this table are the considerable increase in density on passing from the δ- to the ε-phase, and the large difference in density between the densest (α) and the least dense (δ) phase.

Table 3 gives values for the coefficients of thermal expansion of the various phases. In the α-, β- and δ-phases the coefficients vary considerably with the temperature, but in the γ- and ε-phases the expansions are almost linear. The values given are taken at the middle of the appropriate temperature-range.

Table 3. Coefficients of Linear Thermal Expansion (parts in $10^6$/°C.)

| α (below 70° C.) | α (above 70° C.) | β (below 190° C.) | β (above 190° C.) | γ | δ | ε |
|---|---|---|---|---|---|---|
| 40 | 65 | 32 | 54 | 48 | −33 | 20 |

A most interesting feature is the negative temperature coefficient of expansion shown by δ-plutonium. This behaviour is perhaps unique in a polycrystalline pure metal. At the low-temperature end of the stability range of the δ-phase, the coefficient of expansion is very small and becomes negative at high temperatures, getting numerically greater as the temperature increases to the δ → ε change point at 480° C.

The work described above was directed by Mr. G. L. Hopkin, to whom I am indebted for encouragement and advice. I also acknowledge help from

numerous colleagues, particularly Messrs. R. G. Hambling, A. Knight and R. Willows of this Establishment. My thanks are due to Sir William Penney, director of this Establishment, for permission to publish this communication, and to Sir John Cockcroft, director of the Atomic Energy Research Establishment, for facilities.

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Feb. 5.

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Concurrently with the above work, a more extensive programme of research was carried out at the Atomic Energy Research Establishment, Harwell. The transition temperatures between the five allotropic modifications of plutonium have been determined by several methods, the results being summarized in Table 4. The temperatures quoted are approximate typical values, given to the nearest multiple of five degrees: extensive experiments show considerable variations from specimen to specimen. In most cases actual experimental values are within a range of ± 5° C.; but isolated results have been obtained well outside this range.

The electrical resistance and the coefficients of electrical resistance and thermal expansion on heating are given in Table 5. Behaviour on cooling is complicated by severe hysteresis effects and sluggish transformations, so that to quote simple values without extensive qualification would be misleading. Values for cooling are therefore omitted.

The density of α-plutonium has been determined by the displacement method, and values for the other phases have been calculated from the dilatation curves on heating. Variations in the density have been observed from specimen to specimen. The value quoted is for a specimen after standing for several months at room temperature. A typical value for specimens immediately after dilatation runs is about 18·7 gm./c.c., the low figure being presumably due to the retention of other phases. The values given for the β- γ-, δ-, ε-phases are typical for these phases at the lower end of their stable range (Table 6).

Table 6

| Phase | Density (gm./c.c.) |
|---|---|
| α | 19·25 |
| β | 17·3 |
| γ | 16·7 |
| δ | 15·7 |
| ε | 16·3 |

Full discussion of the theoretical implications will become possible only when security limitations permit the disclosure of some other properties of plutonium; but in addition to the negative coefficient of thermal expansion of the δ-phase, and the large density difference between the latter and the α-phase, the following points may be noted:

(*a*) The relatively high values of electrical resistivity and the negative and extremely low temperature coefficients of resistance of some of the phases.

(*b*) The large hysteresis associated with the δ → γ, γ → β and β → α phase-changes, and the complete absence of hysteresis in the onset of the δ-phase change which, however, proceeds only partly to completion, even with long soaking periods.

(*c*) The large variations in properties between one specimen and another, which it is difficult to account for by the presence of impurities if normal experience is taken as a basis for comparison.

Table 4

| Phase | Transition temperatures (°C.) | | | | | |
|---|---|---|---|---|---|---|
| | Thermal analysis* | | Dilatometry† | | Electrical resistance* | |
| | Heating | Cooling | Heating | Cooling | Heating | Cooling |
| $\alpha \rightleftharpoons \beta$ | 140 | 80 | 135 | 80§ | 135 | 90§ |
| $\beta \rightleftharpoons \gamma$ | 235 | 145‡ | 225 | Transformation obscured on all specimens due to sluggishness | 220 | 160‡ |
| $\gamma \rightleftharpoons \delta$ | 325 | 245‡ | 315 | | 325 | 225‡ |
| $\delta \rightleftharpoons \varepsilon$ | 475 | 475 | 480 | 480‖ | 480 | 480‖ |
| Melting and freezing points | 640 | 640 | | | | |

* Rates of heating and cooling, approximately 2 deg. C. per min.
† Rates of heating and cooling, approximately 1 deg. C. per min.
‡ Ill-defined transitions on some specimens; arrests obscured on others.
§ Start of transition: transformation occurs progressively to room temperatures, and sometimes continues isothermally.
‖ On cooling, the change does not appear to go to completion: the density decreases only from 16·3 to about 16·1.

Table 5

| Phase | Resistivity* (micro ohm cm.) | Coefficient of electrical resistance on heating per deg. C. (× $10^{-4}$) | Linear coefficient of thermal expansion on heating per deg. C. (× $10^{-6}$) |
|---|---|---|---|
| α | 150 | − 20 to − 40† | + 50 to 65† |
| β | 116 | − 10 | + 43 |
| γ | 115 | − 4 to − 20‡ | + 39 |
| δ | 111 | + 7 | − 27§ |
| ε | 123 | — | + 20‖ |

* Mean figures for several specimens; they refer to the low-temperature end of each range. The variation from specimen to specimen is about ± 3 micro ohm cm. The values for β-, γ-, δ- and ε- have been corrected for volume changes on the basis of isotropic expansions from the α-phase.
† The curve is not linear; these are limiting values for several specimens.
‡ These are limits for several specimens; one specimen gave a value of + 20 × $10^{-4}$.
§ The curve is not linear over the whole range; this is a typical value for the linear portion of the curve.
‖ Typical value for several specimens; variations from approximately 5 to 30 × $10^{-6}$ have been observed on some specimens.

Many features of the behaviour of plutonium have been necessarily omitted from this short summary; but it is hoped to publish a more detailed account of the experimental results elsewhere.

We wish to thank Dr. H. M. Finniston and Dr. M. B. Waldron for helpful criticism and discussion during the work, and Sir John Cockcroft, director of the Atomic Energy Research Establishment, for permission to publish this communication.

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J. A. L. Robertson
P. Mardon
J. A. Lee
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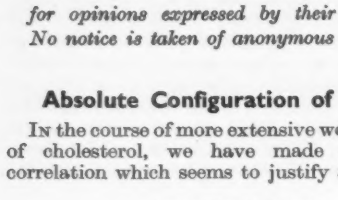
Atomic Energy Research Establishment,
Harwell, Berkshire. Feb. 5.

# LETTERS TO THE EDITORS

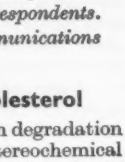
*The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications*

## Absolute Configuration of Cholesterol

In the course of more extensive work on degradation of cholesterol, we have made a stereochemical correlation which seems to justify an interim report.

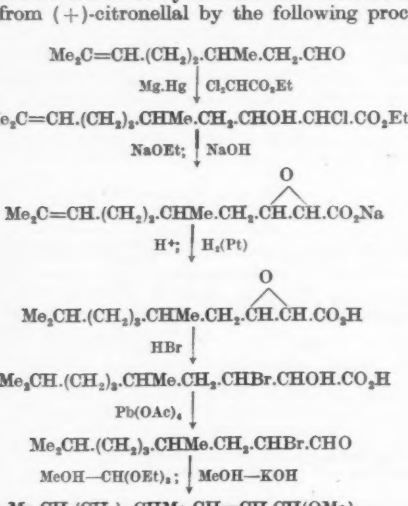



(I)




(II)

Ozonolysis of cholest-14-en-3β-ol (I) and pyrolysis[1] of the product at 210–220° in *cyclo*hexane gave, as one fragment, an αβ-unsaturated aldehyde (II) which formed a crystalline, lævorotatory semicarbazone. We have been able to synthesize this semicarbazone (III) from (+)-citronellal by the following process:




(III)

The semicarbazone from cholesterol had a melting point of 133° (somewhat variable owing to polymorphism), $[\alpha]_D^{20}$ − 24·5° (*c* = 1, dioxan). The semicarbazone from citronellal had a melting point of 133°–135°, $[\alpha]_D^{20}$ − 22° (*c* = 1, dioxan). There was no depression of melting point on admixture. The infra-red spectra (in potassium bromide) were identical. X-ray diffraction photographs of single crystals confirmed the essential identity of the two specimens, though there was a difference in gross crystalline habit, possibly due to slight racemization of one specimen. We are obliged to Mrs. O. Kennard for this comparison and to Dr. R. K. Callow for the infra-red spectra.

The aldehyde (II) contains $C_{(20)}$ of cholesterol as the sole asymmetric centre, and the spatial relationship of $C_{(20)}$ with the other asymmetric centres of cholesterol is known, mainly from the crystallographic analysis of cholesteryl iodide[2]. Briefly, if the absolute configuration of the ring system in steroids is represented correctly by the conventional projection (as in (I), for example), then the absolute configuration about $C_{(20)}$ is represented by (IV)[3].

On the other hand, (+)-citronellal (V) has been degraded to (+)-methyl-succinic acid in the sense indicated by the dotted lines[4]. The latter acid, according to Fredga's evidence[5] obtained from a study of 'quasi-racemates', belongs to the D-glyceraldehyde stereochemical family and has the configuration (VI). If this assignment is accepted, it follows that the assignments (V) and (IV) are also true and that the conventional projection of the steroid molecule really represents the absolute configuration. This confirms the conclusions drawn by Mills[6] from optical rotation differences and by Prelog[7] from the stereochemical course of asymmetric syntheses.

A detailed account of this work will be published elsewhere.

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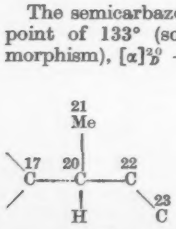
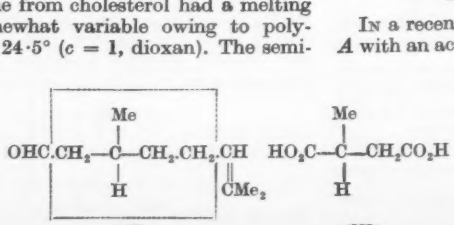
[1] Cf. Achtermann, T., *Z. physiol. Chem.*, **225**, 141 (1934). Laucht, F., *Z. physiol. Chem.*, **237**, 236 (1935), for analogous work with ergosterol.
[2] Carlisle, C. H., and Crowfoot, D., *Proc. Roy. Soc.*, A, **184**, 64 (1945).
[3] Cf. Klyne, W., *Chem. and Indust.*, 426 (1951).
[4] Cf. Birch, A. J., Ann. Reports Chem. Soc., **47**, 192 (1950). Intermediate stages are *iso*pulegol, pulegone and β-methyladipic acid.
[5] Fredga, A., and Leskinen, E., Svedberg Memorial Volume, 261 (1944); *Ark. Kemi, Min. Geol.*, **19** B, No. 1 (1944).
[6] Mills, J. A., *J. Chem. Soc.*, 4976 (1952); *Chem. and Indust.*, 218 (1953).
[7] Prelog, V., *Helv. Chim. Acta*, **36**, 308 (1953). Prelog, V., *et al.*, *Helv. Chim. Acta*, **36**, 320, 325 and 1178 (1953).




(IV)




(V) (VI)

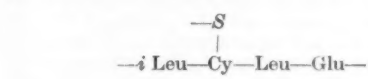
## Structure of Bacitracin *A*

In a recent letter, Porath[1] reported that bacitracin *A* with an activity of 60 units/mgm. could be obtained by chromatography on charcoal. From an analysis of the peptides formed by hydrolysing this material with 6 *N* hydrochloric acid for 72 hr. at 37°, he tentatively suggested a partial structure for the molecule.

We have studied the products of hydrolysis of a sample of commercial bacitracin (Commercial Solvents Cor-

poration, Lot 311, 47 international units/mgm.), and of a sample of bacitracin *A* hydrochloride (72 international units/mgm., corresponding to 77 units/mgm. for the free base) prepared by a short counter-current distribution in the system described by Newton and Abraham[2]. So far as our analysis has proceeded, the two samples have given similar results. The samples were hydrolysed with 11 *N* hydrochloric acid at 37° for periods varying from one to six days, and in some experiments the latent thiol group[3,4] was oxidized to $SO_3H$ with performic acid[5]. Electrophoresis and chromatography on paper were used to separate and characterize the resulting peptides, and 1 : 2 : 4-fluorodinitrobenzene[6] to determine their N-terminal amino-acids. Although a number of these peptides conform to portions of the amino-acid sequence postulated by Porath[1], others appear to have structures which are inconsistent with this sequence as a whole.

After hydrolysis for six days, significant amounts of free histidine, ornithine, aspartic acid and glutamic acid were found. Among the dipeptides which appeared to be present were leucylglutamic acid, β-sulphoalanylleucine and *iso*leucylcysteic acid. Other products included a tripeptide of cysteic acid, leucine and glutamic acid (with cysteic acid as the N-terminal amino-acid) and a tetrapeptide of *iso*leucine, cysteic acid, leucine and glutamic acid (which appeared to have *iso*leucine as the N-terminal amino-acid). These results would require the following sequence to be present in bacitracin *A* :




Further results suggest that the left-hand side of this sequence can be extended through a peptide containing ornithine, phenylalanine and *iso*leucine residues (with ornithine as the N-terminal amino-acid), and that the glutamic acid on the right-hand side is close to aspartic acid. Since the molecule appears to contain a cyclic chain[3,4], this arrangement, like the structure suggested by Porath[1], implies that most of the polar side-chains are grouped together on one part of the ring and most of the non-polar side-chains on the other.

There is general agreement that the δ-amino group of the ornithine residue and the imidazole group of the histidine residue in bacitracin *A* react with 1 : 2 : 4-fluorodinitrobenzene, but that the ε-amino group of the lysine residue is masked[1,3,4]. In addition to the basic groups provided by the ornithine and histidine residues, bacitracin *A* contains a third basic group, which titrates in the region of a peptide α-amino group[6]. Craig, Hausmann and Weisiger[4] have stated that bacitracin *A* behaves as though it contains two free amino groups in the Van Slyke determination of amino-nitrogen. Newton and Abraham[2] reported that, after reaction with 1 : 2 : 4-fluorodinitrobenzene, bacitracin *A* yielded dinitrophenyl-leucine or -*iso*leucine on hydrolysis; but Porath[1] was unable to repeat this observation, and Ingram[7] could demonstrate no N-terminal amino-acid by reductive methylation. We have now confirmed that hydrolysis of our sample of dinitrophenyl-bacitracin *A* yields an ether-soluble dinitrophenyl-derivative which runs on paper chromatograms[8] like dinitrophenyl-*iso*leucine and yields a substance which behaves like *iso*leucine on hydrolysis with baryta[9]. The dinitrophenyl-derivative of commercial bacitracin (which contains some bacitracin *B*) yields, in addition, a substance which behaves like dinitrophenyl-valine. However, the yield of dinitrophenyl-*iso*leucine (and dinitrophenyl-valine), while too large to be neglected, is considerably less than the yield expected from one N-terminal group per molecule. Moreover, an attempt to degrade bacitracin by the method of Edman[10], using the procedure of Landmann, Drake and Dillaha[11] to characterize the products on paper chromatograms, yielded only about 5 per cent of the theoretical amount of 3-phenyl-2-thiohydantoin expected from an N-terminal *iso*leucine. It therefore remains uncertain, from these experiments, whether the third basic group of bacitracin *A* is responsible for the formation of dinitrophenyl-*iso*leucine, or whether this group is part of some hitherto uncharacterized structure in the molecule.

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Jan. 14.

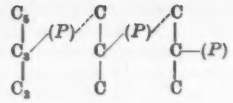
[1] Porath, J., *Nature*, **172**, 871 (1953).
[2] Newton, G. G. F., and Abraham, E. P., *Biochem. J.*, **47**, 257 (1950).
[3] Newton, G. G. F., and Abraham, E. P., *Biochem. J.*, **53**, 597 (1953).
[4] Craig, L. C., Hausmann, W., and Weisiger, J. R., *J. Biol. Chem.*, **200**, 765 (1953).
[5] Sanger, F., and Thompson, E. O. P., *Biochem. J.*, **53**, 353 (1953).
[6] Newton, G. G. F., and Abraham, E. P., *Biochem. J.*, **53**, 604 (1953).
[7] Ingram, V. M., *J. Biol. Chem.*, **202**, 193 (1953).
[8] Blackburn, S., and Lowther, A. G., *Biochem. J.*, **48**, 126 (1951).
[9] Mills, G. L., *Nature*, **165**, 403 (1950).
[10] Edman, P., *Acta Chem. Scand.*, **4**, 277 (1950).
[11] Landmann, W. A., Drake, M. P., and Dillaha, J., *J. Amer. Chem. Soc.*, **75**, 3638 (1953).

## Evidence for the Existence of Two Types of Ribonucleic Acid

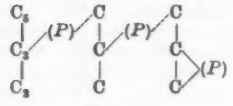
The predominant internucleotide link in ribonucleic acids is now known to be a phosphodiester link between the 3′ position of one nucleoside residue and the 5′ position of the neighbouring residue, regardless of whether the nucleoside residue contains a purine or a pyrimidine[1]. Assuming for the moment that all the nucleic acid chains have equivalent numbers of base and phosphate residues, the chains may be built up in one of two ways. These are represented diagrammatically in formulæ I (*a* and *b*) and II, where $C_2$, $C_3$ and $C_5$ represent positions 2′, 3′ and 5′ of the nucleoside residues, (*P*) a phosphate group; in each case the two terminal and one internal nucleoside residues are depicted.

A ribonucleic acid of type I may be considered as being built up of nucleoside 3′ phosphates, whereas type II is built up of nucleoside 5′ phosphates. For convenience, we shall call those end residues which bear only a phosphate group joining them to the remainder of the chain terminal 'nucleoside residues', and those which bear an additional phosphate group, terminal 'nucleoside 5′', or '3′, or 2′ : 3′ cyclic phosphate residues', depending upon the position occupied by the phosphate group.

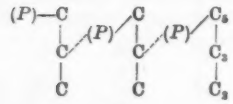
In the ribonucleic acids from yeast and turnip yellow mosaic virus, Markham and Smith[2] showed the presence of two main types of end groups, namely, terminal purine or pyrimidine nucleoside 3′



(Ia)



(Ib)



(II)

(or 2′) phosphates and purine nucleoside 2′ : 3′ cyclic phosphates. The other ends of the chains were assumed to be occupied by nucleoside residues; thus the nucleic acids were taken to be of types I*a* and I*b*.

We now have evidence that, in the case of the ribonucleic acids from tobacco mosaic virus and potato virus *X*, a substantial proportion of the chains are of type II. From Brown and Todd's theory of the acid and alkaline degradation of ribonucleic acid[3], a chain of type I will yield only nucleoside 2′ and 3′ phosphates on alkaline hydrolysis, whereas that of type II will, in addition, give nucleosides from the terminal nucleoside residues, and a mixture of nucleoside 2′ : 5′ and nucleoside 3′ : 5′ diphosphates from the terminal nucleoside 5′ phosphate residues. Tobacco mosaic virus nucleic acid was prepared by heating purified virus to 93° C. for 3 min. in neutral solution in the presence of salt. The denatured protein was centrifuged off and the nucleic acid precipitated by the addition of two volumes of ethanol. When an alkaline hydrolysate (*N* potassium hydroxide at 20° for 18 hr.) of tobacco mosaic virus nucleic acid is run on paper electrophoresis in borate buffer at *p*H 9, in addition to the single band of mononucleotides, two other ultra-violet absorbing bands are observed. One band moving faster than the mononucleotides has the expected mobility of the nucleoside diphosphates. The other migrates more slowly than the mononucleotides, in the position of the ribonucleoside borate complexes.

The nucleoside diphosphates migrate in the expected positions on paper electrophoresis at *p*H 7·4 and *p*H 9 (when they bear four negative charges due to the primary and secondary dissociations of the two phosphate groups) and on paper chromatography in *iso*propanol–water–ammonia[4]. On paper electrophoresis at *p*H 3·5 they separate into three bands corresponding to (*a*) an unresolved mixture of cytidine and adenosine diphosphates, (*b*) guanosine diphosphate and (*c*) uridine diphosphate. On hydrolysis in *N* hydrochloric acid for 1 hr. at 100° and paper chromatography in *iso*propanol–hydrochloric acid[5], the purine nucleoside diphosphates yield adenine and guanine while the pyrimidine nucleoside diphosphates are unchanged and move in the positions of cytidylic and uridylic acids. By these means we have isolated substances with the expected ultra-violet absorption spectra of the diphosphates of adenosine, guanosine and uridine, and which were found to have molar ratios of base to phosphorus of approximately 1 : 2.

The nucleoside band isolated by electrophoresis at *p*H 9 contains ribose but no phosphorus, and on paper chromatography in *n*-butanol–water–formic acid[6] separates into bands moving in the positions of the nucleosides. Adenosine, which occurs in the greatest amount, has been identified by its ultra-violet absorption spectrum.

By hydrolysis with *N* hydrochloric acid and chromatography in *iso*propanol – hydrochloric acid the relative proportions of the four nucleosides and the four nucleoside diphosphates have been measured. These were very different from the proportions of the four nucleotides in the entire nucleic acid. The relative proportions of adenosine among the nucleosides and of uridine diphosphate among the nucleoside diphosphates are considerably higher than those of adenylic and uridylic acids respectively in the whole nucleic acid.

The intact nucleic acid was treated with purified prostate phosphomonoesterase at *p*H 5·3 for 18 hr. at 37°, precipitated with two volumes of ethanol and hydrolysed with alkali. Virtually no nucleoside diphosphates were then found, although the nucleosides had increased relatively in amount. This demonstrated that the diphosphates did in fact originate from terminal residues bearing singly esterified phosphate groups. From the increase in nucleosides, it appears that terminal nucleoside 2′ or 3′ phosphate groups were also present[2].

In tobacco mosaic virus nucleic acid, about one residue in fifty yields a nucleoside diphosphate on alkaline hydrolysis, while the proportion of nucleoside end-groups is somewhat higher. This would suggest that the size of tobacco mosaic virus ribonucleic acid is of the same order as that of the turnip yellow mosaic virus[3] and is considerably smaller than has been deduced from physical measurements[7]. While alkaline hydrolysates of potato virus *X* ribonucleic acid contain similar amounts of nucleosides and nucleoside diphosphates, these substances were not detected in the ribonucleic acid of turnip yellow mosaic virus, thus confirming that the latter is of type I. They appear to be present in small amounts in ribonucleic acids from *Bacterium coli* and mouse liver.

It has been shown that the terminal nucleoside 5′ phosphate residues did not originate during the preparation of the tobacco mosaic virus nucleic acid in the following ways: (1) intact tobacco mosaic virus hydrolysed with alkali gives nucleoside diphosphates; (2) heating turnip yellow mosaic virus nucleic acid, in the way used during the preparation of tobacco mosaic virus nucleic acid, does not lead to the appearance of nucleoside diphosphates in alkaline hydrolysates, and (3) the proportions of nucleosides and nucleoside diphosphates in alkaline hydrolysates of tobacco mosaic virus nucleic acid are not changed by varying the method of preparation of the nucleic acid, or by pretreatment of the virus by grinding or with ultrasonic radiation.

We conclude that, in tobacco mosaic virus and potato virus *X* ribonucleic acids, a large proportion of the chains are of type II. In addition, some of the chains are of type I, while the non-equivalence of nucleosides and diphosphates in alkaline hydrolysates shows that chains with other combinations of the four possible types of end groups must exist.

Examination of the distribution of these different types of end groups in nucleic acids from related strains of the viruses may show differences not apparent in the gross composition of the nucleic acids.

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[1] Cohn, W. E., and Volkin, E., *Nature*, **167**, 483 (1951). Markham R., and Smith, J. D., *Biochem. J.*, **52**, 558 (1952). Brown, D. M., and Todd, A. R., *J. Chem. Soc.*, 2040 (1953). Whitfeld, P. R., and Markham, R., *Nature*, **171**, 1151 (1953). Heppel, L. A., Markham, R., and Hilmoe, R. J., *Nature*, **171**, 1151 (1953).
[2] Markham, R., and Smith, J. D., *Biochem. J.*, **52**, 565 (1952).
[3] Brown, D. M., and Todd, A. R., *J. Chem. Soc.*, 52 (1952).
[4] Markham, R., and Smith, J. D., *Biochem. J.*, **52**, 552 (1952).
[5] Markham, R., and Smith, J. D., *Biochem. J.*, **49**, 401 (1951).
[6] Markham, R., and Smith, J. D., *Biochem. J.*, **45**, 294 (1949).
[7] Cohen, S. S., and Stanley, W. M., *J. Biol. Chem.*, **144**, 589 (1942).

## Detection of Free Hydroxyl Radicals during the Oxidation of Cellulose in Air

IT is well known that when dyed cellulose fabrics are printed with pastes containing the reducing agent sodium sulphoxylate formaldehyde, and steamed, in order to produce a white design on a coloured ground, the white parts of the pattern are sometimes weakened[1,2]. The weakness is due to oxidation of the cellulose at the printed places, and it has been shown that the oxidation occurs only when the fabric is left in humid conditions for some hours after the steaming operation and before the residual printing paste is washed off. During this period the unused reducing agent undergoes oxidation by atmospheric oxygen, and this reaction is accompanied by one in which the cellulose is oxidized. The simultaneous oxidation of sodium sulphoxylate formaldehyde and cellulose, in the absence of the printing adhesives, has recently been investigated in these laboratories. In some of these experiments cellulose fabric was impregnated with a solution of neutral sodium sulphoxylate formaldehyde to which naphthalene-1-sodium sulphonate had been added. The impregnated fabric, after storage in a moist atmosphere for several hours, was made alkaline and treated with an excess of diazotized sulphanilic acid, whereupon a pink colour developed. This pink colour can only have arisen by the coupling of the diazonium compound with a naphthol derived from the naphthalene sulphonate, and it is difficult to conceive any way in which hydroxyl groups can have been introduced into the naphthalene sulphonate except as free hydroxyl radicals (cf. Weiss and Stein[3,4]). No evidence, either of the oxidation of cellulose or of the presence of free radicals, has been obtained when sodium bisulphite, sodium bisulphite formaldehyde, or alkaline sodium sulphoxylate formaldehyde are oxidized on cellulose in this manner. Neutral sodium sulphoxylate formaldehyde is also oxidized quite readily on glass fabric, but without formation of hydroxyl radicals.

It appears, therefore, that free radicals are involved in the oxidation of cellulose under the conditions used in these experiments, and that the radicals can only be detected when both the sodium sulphoxylate formaldehyde and the cellulose are undergoing oxidation simultaneously.

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[1] Taussig, W., *Ciba-Rdsch.*, No. 71, 2643 (1947).
[2] Pinte, Pierret, and Rochas, *Bull. Inst. Text. France*, **3**, No. 15, 43 (1949).
[3] Weiss, J., and Stein, G., *Nature*, **161**, 650 (1948).
[4] Loebl, H., Weiss, J., and Stein, G., *J. Chem. Soc.*, 2074 (1949).

## Electrophoretic Separation on Filter Paper of the Soluble Liver-Cell Proteins of the Rat using Borate Buffer

THE electrophoretic analysis by the ordinary Tiselius apparatus of the soluble proteins isolated from rat liver has already been described[1-3]; but the constituent components reported by these authors differed one from the other.

In order to find a convenient method with consistent results, an electrophoretic separation on filter paper of the soluble proteins of liver cells of the rat was attempted in a way similar to the well-known method for serum proteins. This communication deals with such a separation of the soluble proteins obtained by homogenization and differential centrifugation from livers of healthy rats.

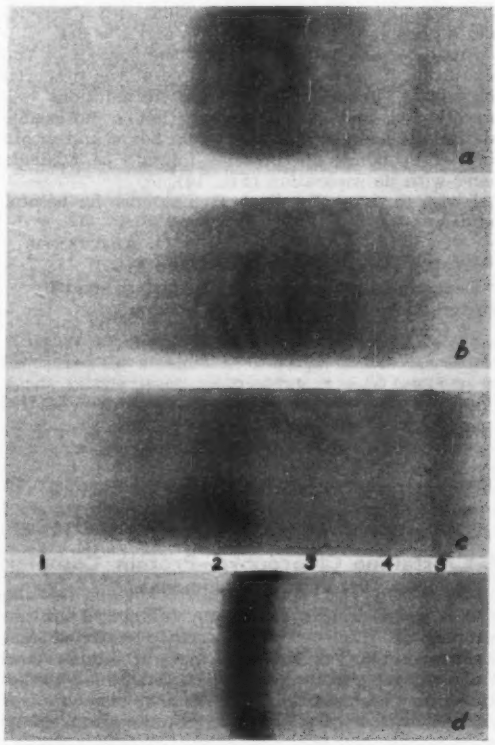


Fig. 1. Electrophoretic separations on filter paper of the soluble liver cytoplasmic proteins of the rat. The strips were stained using naphthalene black. (*a*) Veronal buffer *p*H 8·6, $\mu$ 0·1. (*b*) Phosphate buffer *p*H 8·0, $\mu$ 0·1. (*c*) Borate buffer *p*H 8·6, $\mu$ 0·18. The five bands are numbered from 1 to 5 in order of mobility. (*d*) Material used 48 hr. after preparation (borate buffer)

The following technique has been used for overcoming some difficulties and stabilizing a reproducible method.

A combination of a freeze-drying process and homogenization in isotonic sucrose solution permits a concentration of proteins suitable for paper electrophoresis to be obtained without denaturation of the proteins. The livers removed from the exsanguinated animals were frozen within 15 min. after death and dried *in vacuo*. The gently powdered dried material was suspended in isotonic sucrose solution containing 0·2 per cent of versene, and homogenized with a Potter–Elvehjem glass homogenizer. The isolation of cellular fractions was then carried out by differential centrifugation[4]. The final supernatant containing the soluble cytoplasmic proteins was clear and transparent with *p*H 6·8 and a protein concentration, depending upon the initial dilution, of about 4 per cent.

Immediately after preparation, 0·02 ml. of this solution was allowed to run overnight on strips of Whatman No. 1 filter paper in an electrophoretic apparatus similar to that described for serum proteins[5] (potential gradient 15 V. per cm.).

A series of experiments was carried out to find a suitable buffer solution which would differentiate the velocity of migration of the various protein fractions. The only suitable solution was found to be a borate buffer of *p*H 8·6 and $\mu = 0{\cdot}18$.

A clear resolution of five major protein components was obtained and developed by staining the strips with naphthalene black (Fig. 1*c*). Figs. 1*a* and *b* show the less satisfactory separations with a veronal and a phosphate buffer of *p*H 8·6 and $\mu = 0{\cdot}1$.

An important point on which the success of the separation depends is the freshness of the prepared material. The ageing of the protein solutions was investigated and it was found that a noticeable alteration occurs within twenty-four hours, and within forty-eight hours the proteins migrate as a single band with no separation (Fig. 1*d*).

I wish to thank Dr. D. J. R. Laurence for helpful advice.

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[1] Sorof, S., and Cohen, P., *J. Biol. Chem.*, **190**, 311 (1951).
[2] Henning, N., Kinzlmeier, H., Demling, L., and Mannuss, E., *Klin. Wschr.*, **30**, 390 (1952).
[3] de Lamirande, G., Allard, C., and Cantero, A., *Cancer*, **6**, 179 (1953).
[4] Hogeboom, G. H., Schneider, W. C., and Pallade, G. E., *J. Biol. Chem.*, **172**, 619 (1948).
[5] Grassman, W., Knedel, M., and Hannig, K., *Dtsch. Med. Wschr.*, **76**, 333 (1951).

## A Crystalline Chlorophyll–Protein Complex from *Chlamydomonas*

The isolation of a crystalline chlorophyll–protein complex from clover was recently reported and illustrated by Takashima[1]. Spikes, Lumry and Anderson[2] repeated the crystallization of this complex from thirty species of plants. We have also obtained material with a very similar appearance from many green leaves; for example, clover, *Trifolium repens*; cocksfoot, *Dactylis glomerata*; bracken fronds, *Pteridium aquilinum*. In addition, an apparently crystalline chlorophyll–protein complex has been obtained from a species of alga, *Chlamydomonas*.

*Chlamydomonas dorsoventralis* (Culture Collection of Algae, Cambridge) was grown in an inorganic salt medium[3] aerated with 5 per cent carbon dioxide – air under artificial illumination. The cells were harvested, suspended in a small volume of medium and an equal volume of α-picoline added. The suspension was then centrifuged and dioxan added to the clear green supernatant to a final concentration of 20 per cent. On leaving overnight at 0° C., microscopic green crystals of the chlorophyll–protein complex separated in rosettes. These were recrystallized from α-picoline and dioxan mixture. The material formed roughly equidimensional clusters, each appearing to have grown dendritically from a centre.

Chlorophyll was extracted from the complex by organic solvents, and the absorption spectrum of a solution of the pigment in ether indicated the presence of chlorophylls *a* and *b*. The usual amino-acids were detected by paper chromatography in a hydrolysate of the complex.

Similar crystals were also obtained from a species of marine *Chlamydomonas* kindly provided by Dr. C. P. Spencer. In contrast, the above procedure failed to extract any coloured material from intact cells of *Chlorella vulgaris*, grown with either carbon dioxide or glucose as source of carbon.

We wish to thank Dr. L. Fowden for the culture of *Chlorella* and the Agricultural Research Council for financial support.

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[1] Takashima, S., *Nature*, **169**, 182 (1952).
[2] Spikes, J. D., Lumry, R., and Anderson, D. R., "Investigations on the Reported Crystalline Chlorophyll–Lipoprotein from Green Leaves" (presented at Amer. Soc. Plant Physiologists, Cornell Univ., Ithaca, N.Y., Sept. 7–10, 1952) and cited by Lumry, R., Spikes, J. D., and Eyring, H., in "Ann. Rev. Phys. Chem.", **4**, 405 (1953).
[3] Hunter, S. H., and Provasoli, L., in Lwoff, A., "Biochemistry and Physiology of Protozoa", **1**, 107 (Academic Press, Inc., N.Y., 1951).

## Separation and Estimation of Chitosamine and Chondrosamine in Complex Hydrolysates

The estimation of hexosamines in hydrolysates of complex biological materials, containing both protein and carbohydrate parts, has for some years been recognized as one of the more important analytical problems of biochemistry. The separation and identification of the two hexosamines, chitosamine (glucosamine) and chondrosamine (galactosamine), known to occur in the animal organism, is likewise difficult. The use of ion-exchange resins offers a convenient technique for separating the hexosamines from each other and from other substances.

Moore and Stein[1] report the position of a hexosamine peak using elution chromatography with both 100-cm. and 15-cm. columns of 'Dowex 50' resin. Partridge and Elsden[2] have separated chitosamine from chondrosamine on 100-cm. columns of 'Dowex 50'; the peaks emerge in the region 250–350 fractions from the beginning of the run where the citrate buffer of *p*H 4·25 is emerging. Unfortunately, the hexosamine peaks overlap some of the amino-acid peaks, necessitating the analysis of alternate fractions by the ninhydrin[3] and the Elson and Morgan[4] methods, respectively, to enable a distinction to be made. In addition, we have found the position of the peaks

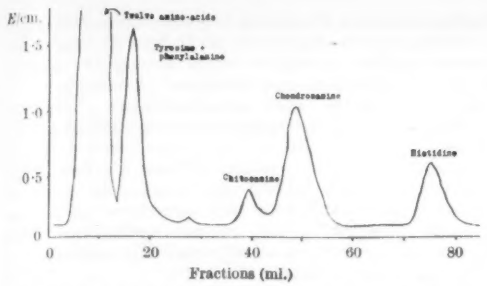


Fig. 1. A portion of a chromatogram of a protein - carbohydrate complex hydrolysate on a 15-cm. column of 'Dowex 50', showing separation of the hexosamines

liable to vary somewhat according to an unknown factor, possibly the flow-rate. Gardell[5] has separated glucosamine from galactosamine on 'Dowex 50' columns using 0·3 *N* hydrochloric acid as eluant, and Boas[6] used the same resin to remove interfering substances from hexosamine solutions. Both authors utilized modified Elson and Morgan[4] techniques to determine the hexosamines.

Recently, in connexion with the analysis of a protein – carbohydrate complex isolated from compact bone, we have succeeded in separating chitosamine and chondrosamine quantitatively on 15 cm. × 0·9 cm. columns of 'Dowex 50' using the standard procedure of Moore and Stein[1]. The positions of the peaks are shown in the accompanying figure, where the optical density of the solution, compared with water, is plotted against the fraction number. The chitosamine peak at fraction 40 is well separated from the chondrosamine peak at fraction 50. The hexosamine peaks are also separated from tyrosine and phenylalanine, from the amino-acids emerging before these and from the small peak at fraction 28, which is an artefact arising from the change of buffer at fraction 23 (0·1 *M* sodium citrate, *p*H 4·95 to 0·1 *M* sodium phosphate, *p*H 6·75). Histidine and hydroxylysine (not shown in the figure) emerge after the hexosamines and without overlap. The only known amino-acid emerging with the hexosamines is tryptophan, which is unlikely to cause difficulty in hydrolysates, since it is completely destroyed on heating with acid.

The complete separation of the hexosamines from amino-acids on the 15-cm. column enables the reliable ninhydrin procedure[2] to be used for estimation in place of the less accurate method of Elson and Morgan[4]. Convenience is also gained, compared with the use of the 100-cm. column, since a smaller number of fractions is required for the emergence of the amino-sugars. Both chitosamine and chondrosamine give the same colour intensities with ninhydrin as an equimolecular weight of leucine, that is, colour yield is 1·00[3]. Both hexosamines were recovered quantitatively from the column, when added as the pure hydrochlorides. The method, therefore, provides an accurate means of determining small quantities of chitosamine and chondrosamine in hydrolysates of complex polysaccharides, whether or not proteins are also present. The decomposition of hexosamines, in the presence of amino-acids, under the initial hydrolysis conditions has not been fully investigated. More than 98 per cent of the total nitrogen, as shown by the ninhydrin-positive components, was recovered from a protein – carbohydrate complex, which contained 8 per cent of hexosamines and more than 60 per cent of amino-acids, after 0·05 gm. was hydrolysed with 10 ml. of 20 per cent w/w hydrochloric acid at 100° for 24 hr. It would thus appear that the amount of breakdown is small when a large excess of acid is used for hydrolysis.

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[1] Moore, S., and Stein, W. H., *J. Biol. Chem.*, 192, 663 (1951).
[2] Partridge, S. M., and Elsden, D. F. (private communication).
[3] Moore, S., and Stein, W. H., *J. Biol. Chem.*, 176, 367 (1948).
[4] Elson, L. A., and Morgan, W. T. J., *Biochem. J.*, 27, 1824 (1933).
[5] Gardell, S., *Acta Chem. Scand.*, 7, 207 (1953).
[6] Boas, N. F., *J. Biol. Chem.*, 204, 553 (1953).

## Cleavage of the 2 : 4-Dinitrophenylhydrazones of Ketones

The interesting contribution of J. Demaecker and R. H. Martin[1] on this subject prompts me to mention an alternative method which was devised in the course of work (1946) in the strychnine series.

The ketone 4-nitrophenylhydrazone or 2 : 4-dinitrophenylhydrazone was heated on the steam-bath with 80 per cent formic acid (or stronger) and copper carbonate added. The end-point was in most cases indicated by the disappearance of colour. In this process the nitro- or dinitro-phenylhydrazine produced by hydrolysis is destroyed by oxidation, and, however unfavourable the equilibrium between hydrazine and hydrazone may be, the liberation of ketone goes to completion. The method was found to be generally applicable, and the yields of ketone were high.

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[1] *Nature*, 173, 266 (1954).

## Preparation of Monodeuteriomethyl Bromide

The exchange of deuterium and hydrogen has prevented the attainment of a high degree of isotopic purity in the preparation of compounds of the type $CH_2DX$, where $X$ is a halogen atom or hydroxyl group. $CH_2DOD$ has been prepared by the action of diazomethane on heavy water. Halford *et al.*[1] acidified the $D_2O$ with $SO_3$. No exact indication of the isotopic purity of the product was obtained[2]. Langseth and Bak[3] claimed that about 10 per cent $CH_3OH$ was present in $CH_2DOD$ prepared by the same method due to water unavoidably present in the $CH_2N_2$. Beersmans and Jungers[4] repeatedly bubbled gaseous $CH_2N_2$ through $D_2O$ until reaction was complete. The product was a mixture of all the different isotopic forms. Without acidification the reaction may proceed by a free radical mechanism[5] leading to exchange. The methyl bromide prepared by esterification with HBr (in which no exchange occurs) contained 51 per cent $CH_2DBr$ and $CHD_2Br$ [6].

I prepared $CH_2DBr$ in about 93 per cent isotopic purity by the direct action of $CH_2N_2$ and DBr in dibutyl ether[7]. The reagents are difficult to handle on a large scale, and it does not seem possible to avoid exchange with such reactive materials.

$CH_2DBr$ has now been prepared in high yield by the method:

$$CH_2CO + D_2O \rightarrow CH_2D.COOD$$

$$CH_2D.COOD + CH_2CO \rightarrow (CH_2D.CO)_2O$$

$$(CH_2D.CO)_2O + Ag_2O \rightarrow 2\,CH_2D.COOAg$$

$$CH_2D.COOAg + Br_2 \xrightarrow{CCl_4} CH_2DBr + CO_2 + AgBr.$$

Ketene was prepared in the standard way[8] and bubbled directly through $D_2O$. The acetic anhydride, after fractional distillation, combined directly with dry $Ag_2O$. The method of Bockmuller and Hoffman[9] was followed in the bromination.

Mass-spectrometric analysis indicated about 5 per cent $CH_3Br$ in the product. This agreed with the analysis of the anhydride and indicated that exchange did not occur in the last steps of the reaction.

Langseth and Bak[3] prepared $CH_2D.COOCH_3$ in high isotopic purity by partial acid hydrolysis of dimethyl malonic ester in $D_2O$ followed by decarboxylation of the resultant mono-ester. Silver acetate was prepared from the acid, and the methyl bromide produced by bromination as above was a mixture of $CH_3Br$, $CH_2DBr$, $CHD_2Br$ and $CH_3Br$. The exchange was presumed to occur in the last step.

In view of the above results, it is more probable that water, formed in the action of acetic acid on silver oxide, was exchanged with the methyl group of the silver acetate[10,11].

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[1] Halford, J. O., Anderson, L. C., and Kissin, G. H., *J. Chem. Phys.*, **5**, 927 (1937).
[2] Halford, J. O. (private communication).
[3] Langseth, A., and Bak, B., *Kgl. Danske Vidsk. Selsk. Mat. Phys. Medd.*, **24**, No. 3 (1947).
[4] Beersmans, J., and Jungers, J. C., *Bull. Soc. Chim. Belg.*, **56**, 72 (1947).
[5] Palazzo, C., *Gazz. Chim. Ital.*, **79**, 13 (1949).
[6] Beersmans, J., and Jungers, J. C., *Bull. Soc. Chim. Belg.*, **56**, 238 (1947).
[7] Andersen, F. I., Proceedings of Conference on Applications of Isotopes in Scientific Research, 195 (University of Melbourne, 1950).
[8] Williams, J. W., and Hurd, C. D., *J. Org. Chem.*, **5**, 122 (1940).
[9] Bockmüller, W., and Hoffman, F. W., *Annalen*, **519**, 165 (1935).
[10] Herbst, R., and Rittenberg, D., *J. Org. Chem.*, **8**, 380 (1943).
[11] Miklukhin, G. P., *Dok. Akad. Nauk. U.S.S.R.*, **70**, 439 (1950).

## Properties of the Calcium Phosphates

Workers on the chemistry of soils and fertilizers have to deal with phosphorus compounds, many of which are complex or of indefinite composition. It is likely that, if fundamental information were available concerning those compounds of fairly well-defined composition, the transformations occurring during manufacture and after application to the soil might be more understandable.

The most widely used phosphate fertilizer is superphosphate, which consists mainly of monocalcium phosphate and calcium sulphate. It depends for its production upon the use of large quantities of sulphuric acid. Past shortages and doubts concerning future supplies of this acid are among the reasons focusing attention on fertilizers containing more basic phosphates such as dicalcium phosphate, hydroxyapatite and materials of composition between these.

A co-operative programme of work has been commenced in these laboratories aiming in the first instance at establishing the structures of certain calcium phosphates and at developing laboratory techniques permitting an approximate evaluation of their agronomic value.

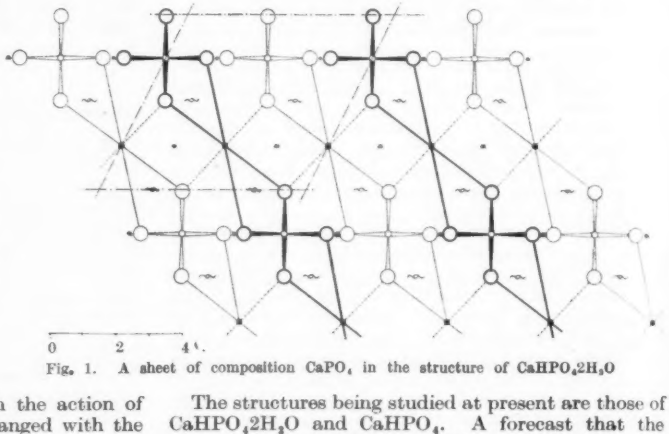

Fig. 1. A sheet of composition $CaPO_4$ in the structure of $CaHPO_4.2H_2O$

The structures being studied at present are those of $CaHPO_4.2H_2O$ and $CaHPO_4$. A forecast that the former structure would be similar to that of gypsum has already been made[1], and we have confirmed the correctness of this by single-crystal X-ray methods.

The unit cell dimensions of $CaHPO_4.2H_2O$ are: $a = 5{\cdot}812$, $b = 15{\cdot}180$, $c = 6{\cdot}239$ A., $\beta = 116°\ 25'$. These data correspond to a different choice of $a$-axis (and of $\beta$) from that used by Wooster for gypsum[2]. Wooster's values were apparently taken from Onorato[3]. The space group of $CaHPO_4.2H_2O$ is $I\,2/a$ and the cell contains four formula units. The Ca and P (and probably the H also) are on the two-fold axes, the $y$ parameters of Ca and P differing by exactly a half. These positions of the heavy atoms enable a complete structure determination to be carried out by Fourier methods, and this work has now been almost completed.

In Fig. 1 (a projection along the $b$-axis), $PO_4$ groups are represented by oxygen atoms arranged tetrahedrally around the central phosphorus atom. The calcium atoms have six of their eight co-ordination positions occupied by oxygen atoms from $PO_4$ groups and the remaining two are filled by water molecules. The basic structure can conveniently be regarded as being built of sheets containing parallel chains of composition $=PO_4=Ca=PO_4=Ca=$. These run down from left to right in Fig. 1. Adjoining chains in any one sheet differ in height by 2·3 A. to give a corrugation effect. The higher set of chains is related to the lower by centres of symmetry between the $PO_4$ groups and between the calcium ions of different chains. The corrugated sheets themselves are repeated at a separation of $b/2 = 7{\cdot}59$ A. by vertical screw axes. Between the sheets are the water molecules, each molecule linking a calcium atom and an oxygen atom in one sheet to an oxygen atom in an adjacent sheet.

The minor differences between the structure of the $CaHPO_4 2H_2O$ and $CaSO_4 2H_2O$ are probably associated with the fact that the former is the hydrate of an acid salt. This work will be published in full elsewhere. Our thanks are due to the Research Department of the Tennessee Valley Authority for supplying some materials for this work

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[1] Hill, W. L., and Hendricks, S. B., *Indust. Eng. Chem.*, **28**, 440 (1936).
[2] Wooster, W. A., *Z. Krist.*, **94**, 375 (1936).
[3] Onorato, E., *Z. Krist.*, **71**, 277 (1929).

## Ignition of Methane – Air Mixtures by Rapid Compression

IN an earlier communication[1], the occurrence of bright blue flames by rapid adiabatic compression of methane – air mixtures was reported. Similar observations have recently been reported for methane by other workers[2,3] using the motored engine technique.

In recent experiments we have improved our original method in which the compression ratio of the motored engine was increased to approach the ignition boundary. A machine of fixed compression ratio of 14·7 : 1 is now used with an accurately controlled preheat charge temperature. The charge temperature and the mixture composition can be varied with continuous observation of the ignition flame, and in this way the regions of reaction may be charted. The separate regions of blue and yellow flames are clearly distinguished in Fig. 1. It is seen that ignition boundaries have been established at mixture ratios far weaker than have previously been recorded by the motored engine method. A broad and stable region of blue flame has been discovered making possible spectroscopic observation of the light emission. These investigations are proceeding.

A study of the products of reaction has revealed an initial slow reaction for which no radiation has been detected and for which carbon monoxide appears as a delayed product. A boundary for the initial detection of carbon monoxide is shown as the line *AB* in Fig. 1. Continuous measurement of the composition of the products has shown that the carbon monoxide concentration increases very sharply as the blue ignition limit is approached and that a sharp drop in concentration occurs with the appearance of the blue flames. The lower blue flame boundary is sharp and very reproducible. A similar variation in the products of reaction of weak methane – air mixtures has been found by Burgoyne and Hirsch[4] using an entirely different experimental method in which the mixture reacts when flowing through a heated tube. The carbon monoxide formed by slow oxidation of the methane has been shown to oxidize rapidly at a sharply defined temperature.

In Figs. 2 and 3 simultaneous pressure and luminosity diagrams are given for typical blue and yellow ignitions. It will be seen that the yellow ignition reaction is early in the cycle and is marked by a steep pressure rise. The blue ignition, at the same temperature, but with a weakened mixture, occurs late in the cycle and shows a less steep rate of pressure rise. The corresponding luminosity diagrams were recorded with a gas-filled photo-cell using an Ilford Spectrum Violet Filter. It is seen that the blue radiation predominates in the yellow ignition flame.

The results now presented show that the blue ignition reactions of methane can occur at very lean mixtures under favourable temperature and pressure conditions. The exact nature of the two modes of ignition is still not clear. It is hoped that, since the cyclic regularity of both blue and yellow ignitions is satisfactory even close to the ignition boundaries, it will be possible to obtain emission spectra and thus elucidate the two mechanisms of ignition.

This work is supported by the Ministry of Fuel and Power.

*Note added in proof, February 26.* Spectroscopic studies in collaboration with Dr. A. G. Gaydon have now shown that the light emission in the blue region shows a strong continuum of burning carbon monoxide on which a well-defined banded structure is superimposed. This structure has been identified as that

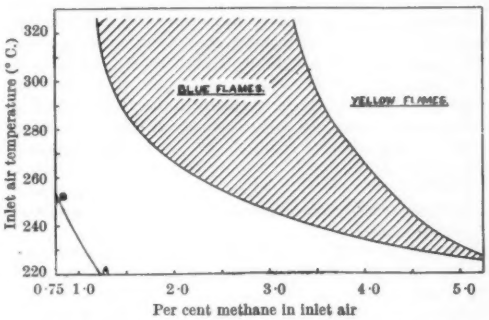


Fig. 1. Ignition boundaries for methane–air mixtures

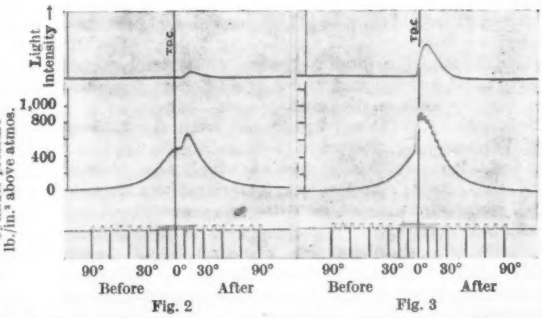


Fig. 2




Fig. 3

Fig. 2. Blue ignition: 4·04 per cent methane in air; ignition 6° after top dead centre; rate of pressure rise, 39 lb./in.²/deg. crank angle. Fig. 3. Yellow ignition: 4·67 per cent methane in air; ignition 4° before top dead centre; rate of pressure rise, 172 lb./in.²/deg. crank angle.
Inlet charge temperature, 243° C.; engine speed, 1,000 r.p.m.; water outlet temperature, 60° C.; oil temperature, 40° C.

of excited formaldehyde. Towards the yellow boundary the bands of HCO and OH appear. The spectrum of the yellow region gives a carbon continuum, despite the extreme weakness of the mixture. A full account of the spectroscopic work is in preparation.

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[1] Egerton, A. C., Moore, N. P. W., and Lyn, W. T., *Nature*, **167**, 191 (1951).
[2] Downs, D., Wheeler, R. W., and Walsh, A. D., *Phil. Trans. Roy. Soc.*, A, **243**, 463 (1951).
[3] Downs, D., Street, J. C., and Wheeler, R. W., *Fuel*, xxxii, **3**, 279 (1951).
[4] Burgoyne, J. H., and Hirsch, H. (in course of publication); see also Hirsch, H., Ph.D. thesis, London, "The Oxidation of Methane" (1953).

## Influence of Cation-Exchange Resins on Adenosine Triphosphate

Cation-exchange resins provide a convenient means of obtaining free acids from their salts, and the use of resins for obtaining adenosine triphosphate (ATP) from its barium salt has been described[1-3].

We have found that ATP which has undergone treatment by a cation-exchange resin behaves unexpectedly when chromatographed on paper. ATP was prepared from $Ba_2ATP.4H_2O$ (Schwarz : New York) by shaking it in aqueous suspension with 'Amberlite *IR*-120(H)'. When chromatographed according to the method of Burrows, Grylls and Harrison[4] (solvents 2, 4 and 7), the ATP was located in the position normally occupied by adenosine diphosphate (ADP). Similar anomalous $R_F$ values were obtained when a barium salt prepared from ATP (free acid supplied by Light of Colnbrook) was shaken with 'Amberlite *IR*-120(Na)' or '*IR*-100(H)'; or dissolved in acetic or formic acid and passed through a column of '*IR*-120(Na)'.

In order to confirm that the resin was responsible for the increase of $R_F$ value, aqueous solutions of ATP (Light) were shaken with '*IR*-100(H)' or '*IR*-120(Na)'. Increased $R_F$ values were again found. Similar effects were obtained whether the treated ATP was applied to the paper directly or after evaporation (either as the free acid or in neutral solution) to small bulk at 0° C. under reduced pressure. Under the same conditions the $R_F$ values of ADP and adenosine monophosphate were unchanged. Treated and untreated samples of ATP were normally run side by side on the same paper.

Solutions of ATP were prepared from the barium salt (Schwarz) by treatment with sulphuric acid and divided into two parts, one of which was shaken with '*IR*-120(H)'. Electrometric titrations showed small significant differences between resin-treated and untreated solutions. Measurement at five-minute intervals of orthophosphate liberated by *N* acetic acid at 100° C. during two hours showed no difference in the hydrolysis-rates of resin-treated and untreated solutions.

A sample of ATP (Light), when chromatographed on paper, gave two well-separated bands, which on elution and analysis were found to have the appropriate total-to-hydrolysable phosphate ratios for ATP and ADP respectively. The presence of both ATP and ADP in the sample had been previously confirmed by separation on an anion-exchange column according to the procedure of Cohn and Carter[5]. After treatment with 'Amberlite *IR*-120(H)' resin, paper chromatography of the same sample gave one band only, in the ADP position. When the material from this band was eluted, concentrated by evaporation at 0° C. under reduced pressure and rechromatographed, two bands appeared corresponding to ATP and ADP.

Analogous treatment of the ADP band from an untreated sample of ATP also produced a chromatogram with some material in the ATP position. It is suggested that some samples of ATP may therefore contain two forms of the compound having different characteristics.

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[1] Polis, B. D., and Meyerhof, O., *J. Biol. Chem.*, **169**, 389 (1947).
[2] Rowles, S. L., and Stocken, L. A., *Biochem. J.*, **47**, 489 (1950).
[3] Slater, E. C., *Biochem. J.*, **53**, 157 (1953).
[4] Burrows, S., Grylls, F. S. M., and Harrison, J. S., *Nature*, **170**, 800 (1952).
[5] Cohn, W. E., and Carter, C. E., *J. Amer. Chem. Soc.*, **72**, 4273 (1950).

## Deoxypentose Nucleic Acid in the Expressible Fluid of Cod Fillets

When fillets of fish are allowed to stand for some time under humid conditions, there is invariably an exudation of a cloudy fluid or 'drip'. If submitted to pressure, the fillets lose fluid ('expressible fluid') at a much faster rate. It has been observed by numerous workers that when the tissue is frozen there is an increase in both the 'drip' and the 'expressible fluid'. A method has been worked out in this laboratory for measuring the amount of 'expressible fluid' that can be obtained from whole fillets cut from fresh and frozen fish. The conditions that are employed are such that it is believed that no appreciable rupture of cells occurs during the time that the fillets are submitted to pressure, and that the exudate consists, therefore, almost entirely of intercellular fluid.

Since deoxypentose nucleic acid (DNA) is found only in cell nuclei, it seemed likely that if any were found in the 'expressible fluid' it would be indicative of cell rupture, with liberation of nuclear material into the interstices. Accordingly, DNA was determined in a large number of samples of 'expressible fluid' obtained from fish treated in different ways. The separation was accomplished with a modified Schmidt–Thannhauser[1] procedure, and the DNA phosphorus was determined by the method of Berenblum and Chain[2].

It was found that the 'expressible fluid' from fresh undamaged fillets always contained some DNA (*c.* 0·12 mgm. DNA phosphorus per 100 ml.) which probably had its origin in nuclear material exuding from the severed cells at the cut surface of the fillets. This view was supported when a large number of fillets was allowed to drain on sloping trays for 24 hours in a saturated atmosphere, without applying pressure. More DNA (*c.* 0·4 mgm. DNA phosphorus

per 100 ml.) was found in the small quantity of 'drip' obtained than in the 'expressible fluid' from similar fillets. Thus the application of pressure released further fluid of lower DNA concentration, presumably intercellular fluid.

The effect of mechanical damage was illustrated by dividing some similar cod fillets into three groups. The first was pressed under the standard conditions for six hours, the second minced once through a domestic mincer, and the third minced with a domestic mincer and the product put through a Latapie mincer. The two portions of mince were centrifuged at 3,500*g* for half an hour, and the supernatant fluid poured off. The concentrations of DNA phosphorus were respectively 0·124, 0·380 and 0·807 mgm. per 100 ml. fluid. These results suggest that, whereas the action of a domestic mincer is mostly a tearing apart of the muscle fibres, the Latapie mincer actually breaks the fibres up.

The effect of keeping cod on ice for several days before filleting was small. The DNA-level remained fairly constant from 2 to 9 days, and thereafter showed a small continuous rise, data being obtained up to 16 days. It is suggested that this small rise may be due to the synthesis of DNA by bacteria.

Striking results were obtained when the DNA content of the 'expressible fluid' of fish frozen at different rates was measured. Two effects were shown: (1) In a series of fillets that were frozen more and more quickly, DNA phosphorus levels rose very gradually (from *c.* 0·2 to 0·3) as freezing-rate increased, and then suddenly rose to a sharp maximum (0·6), falling again to a low level (0·2) as the rate increased further. Microscopic examination of the frozen fish indicated that this maximum corresponded with the entry of ice crystals into the muscle cells.

It has been known for some time that in slowly frozen muscle there are large ice crystals which form between the fibres, whereas in rapidly frozen tissue the crystals are small and within the fibres. This DNA maximum marks the change-over point, where the cooling is just rapid enough to produce intracellular crystals, but where the latter are so big that they rupture the sarcolemmas and liberate nuclear material. As the freezing-rate increases further, the size of the crystals diminishes, leaving the sarcolemmas intact.

(2) When the fillets were frozen very rapidly indeed, as in liquid oxygen and in $CO_2$-alcohol, there was a further rise in DNA phosphorus concentration to *c.* 0·5 mgm. per 100 ml. This rise was probably caused by a hard frozen layer forming around the fillet, which tended to prevent the inside from expanding when it froze later, thus setting up a sudden great internal pressure. Fillets frozen more slowly presumably retained a 'cheesy' consistency sufficiently long to permit accommodation to the stresses set up. A similar effect occurred in fillets packed tightly twelve deep in a box and frozen from two opposite faces. The fillets froze from the cooling surfaces towards the centre, and it was found that the fillets at the centre of the box, which were the last to freeze, and which in this instance froze at very slow rates, had high levels of DNA phosphorus in the 'expressible fluid' (*c.* 0·5 and 0·75 mgm. in two experiments). It is probable that damage to these fillets was caused by their expanding against the restrictions set up by the hard outer masses of the already frozen fish.

It should be emphasized that the fillets were all cooled to the same final temperature, whatever the rate of freezing, and all were thawed under the same conditions.

It is commonly held that muscle tissue is damaged less and less the more rapidly it is frozen. The results described here indicate that this belief is too simple.

A full account will be published elsewhere.

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[1] Schmidt, G., and Thannhauser, S. J., *J. Biol. Chem.*, **161**, 83 (1945).
[2] Berenblum, I., and Chain, E., *Biochem. J.*, **32**, 295 (1938).

## A Bacterial Toxin paralysing Silkworm Larvæ

Certain strains of *Bacillus cereus* are among the more virulent known bacterial pathogens of the silkworm, *Bombyx mori* L.[1]. Toumanoff and Vago[2,3] isolated a strain of *B. cereus* (*B. cereus* var. *alesti*) which causes toxæmia, a septicæmia and intermediate conditions in silkworm larvæ. Another strain of *B. cereus* (*B. cerus* var. *sotto*) was studied by Aoki and Chigasaki[4], who suggested that its effect was due to a toxin. A culture of *B. sotto* was kindly made available by Mr. Masatake Ono, of Tokyo, and the disease caused by it has been under investigation in this laboratory since early in 1953.

The work of Aoki and Chigasaki[4] has been confirmed. Two conditions have been observed in larvæ infested with *B. sotto*: a profound paralysis 2 or 3 hr. after ingestion of old cultures and a septicæmia without paralysis 12–24 hr. after injection of spores and cells into the body cavity. The rapid onset of paralysis, which took place without any discernible increase of the ingested bacteria, was suggestive of the presence of a pre-formed toxin; but no toxin could be demonstrated in culture media in which the bacteria had been grown.

It was found in our experiments that treatment of old cultures of *B. sotto* with clarified silkworm gut juice yielded a toxic extract. As silkworm gut juice is normally alkaline (*p*H 9·5–10·0), an old culture of *B. sotto* was treated with dilute alkali and filtered through a fritted glass filter. The sterile filtrate caused paralysis of silkworm larvæ. Hannay[5] has recently observed alkali-soluble crystalline inclusions in sporulating cells of strains of *B. cereus* known to be pathogenic for insect larvæ. Microscopical examination of *B. sotto* revealed similar crystals. Treatment of a suspension of spores, crystals, and vegetative debris with alkali resulted in the dissolution of the crystals without affecting the viability of the spores.

An experiment was done to test whether there might be any foundation to the speculation made by Hannay[5] that the crystals might be a toxic substance encouraging septicæmia of the insect larvæ. A suspension of crystals, spores and vegetative debris of *B. sotto* was well washed by centrifugation, resuspended in water, and divided into two parts. One part was diluted and tested against silkworm larvæ both by injecting a quantity of it into the body cavity and by feeding. The second part was treated with alkali until the crystals had dissolved, then the spores and debris were centrifuged out, well washed by centrifugation and resuspended in water. A

THE EFFECT OF FEEDING AND INJECTING LARVÆ OF *Bombyx mori* L. WITH FRACTIONS OF AN ALKALI-TREATED CULTURE OF *B. sotto*

| | Method of dosing larvæ | |
|---|---|---|
| | By feeding | By injection |
| *Original culture* | | |
| Spores and crystals ($1 \times 10^8$ spores per larva) | Paralysis within 4 hr., septicæmia within 12 hr. | Septicæmia within 12 hr. No paralysis |
| *Alkali-treated culture* | | |
| 1. Spore fraction ($1 \times 10^7$ spores per larva) | No effect | Septicæmia within 12 hr. |
| 2. Supernatant | Paralysis within 4 hr. No septicæmia | No effect |
| 3. Supernatant dialysed | Paralysis within 4 hr. No septicæmia | No effect |
| 4. Supernatant heated at 70° C. for 30 min. | No effect | No effect |

portion of the supernatant was dialysed against water and another portion heated at 70° C. for 30 min. All four fractions were tested by feeding and injection. The results are given in the accompanying table.

The results indicate that the septicæmia following feeding is dependent upon the presence of a toxic substance which is heat-labile and non-dialysable. The toxin had a paralytic effect when fed but was non-toxic when injected. The crystal-free spores, on the other hand, were pathogenic when injected but non-invasive when fed.

By differential centrifugation of a suspension of spores and crystals, two fractions were obtained which differed significantly in the ratio of spores to crystals. It was found by feeding various dilutions of the two fractions that toxicity varied as the crystal count and was independent of the number of spores present.

The results presented above indicate that the toxic component in old cultures of *Bacillus sotto* responsible for paralysis in silkworm larvæ is associated with the crystalline inclusions described by Hannay. The investigation of its nature and mode of action is being continued.

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[1] Steinhaus, E. A., "Principles of Insect Pathology" (McGraw-Hill, N.Y., 1949).
[2] Toumanoff, C., and Vago, C., *Ann. Inst. Pasteur*, **84**, 376 (1953).
[3] Toumanoff, C., and Vago, C., *Ann. Inst. Pasteur*, **82**, 512 (1952).
[4] Aoki, K., and Chigasaki, Y., *Mitt. Mediz. Fakult. Kais. Univ. Tokio*, **14**, 59 (1915).
[5] Hannay, C. L., *Nature*, **172**, 1004 (1953).

## Buds on the Roots of the Rosebay Willow-herb (Fireweed)

SEVERAL investigators have previously recorded the presence of buds on the roots of the rosebay willow-herb or fireweed (*Chamaenerion angustifolium* (L.) Scop.)[1-4], and the purpose of the present work was to obtain a more complete picture of the formation of these root buds.

On the surface of the roots of *Chamaenerion* are small pit-like depressions. These depressions mark the position of the root traces on secondarily thickened roots in their first year of growth; but according to Moss[5] in older roots with one or more interxylary periderms the depressions result from the disorganization of young buds and lateral roots. Buds and lateral roots originate within the proximity of these depressions, and in order to obtain a succession of stages in the formation of lateral roots and buds the depressions were first marked with indian ink and root cuttings, several centimetres long, grown in a constant-temperature room (21° ± 1° C.) on filter paper kept moist with distilled water. Every other day one or two cuttings were removed and microtome sections cut in the region of the depressions. Unfortunately, very early stages in bud formation could not be detected with certainty since the buds originated from tissues which were already meristematic. However, it has been found that they are endogenous in origin and arise from the external phellogen and its immediate derivatives (Fig. 1). Lateral roots also originate from the external phellogen and its immediate derivatives, and like the buds they are endogenous and rupture the outer tissues of the periderm as they emerge.

Fig. 1. A root bud of *Chamaenerion angustifolium* (L.) Scop. in the proximity of a root trace (at *X*, but not entirely in the plane of the section). The bud has ruptured the outer tissues of the periderm. (× 75)

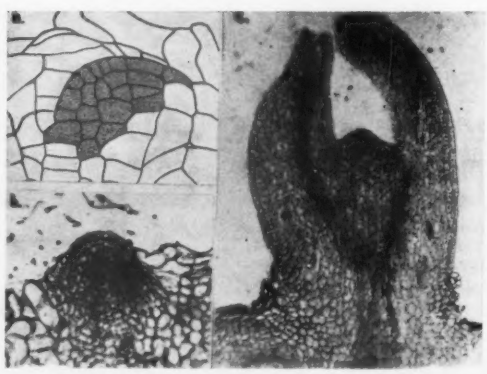

Fig. 2. Stages in bud formation at the distal cut surfaces of decapitated buds: (*a*) camera lucida drawing of initial activity involving cells just below the cut surface (× 327); (*b*) the adjacent cells above the meristem have ruptured (× 120); (*c*) later stage in bud formation (× 60)

Root cuttings produced not only buds and roots but also small green hemispherical mounds. After a few days, shoots, a number of which were fasciated, and very occasionally roots, developed from these mounds. Microtome sections revealed that the mounds developed from the distal cut surface of decapitated buds. The first indication of the formation of a bud meristem was seen in a group of deeply stained cells just below the surface of a mound. At this stage only a few cell layers were involved (Fig. 2 *a*); but gradually the tendency to become meristematic extended inwards. As the meristem increased in size a tunica and corpus became distinguishable and ultimately the adjacent cells above ruptured, disintegrated and the meristem became freely exposed on the surface of the mound (Fig. 2 *b*). Leaf primordia were later formed and prevascular strands differentiated downwards to the cambium of the decapitated bud (Fig. 2 *c*). These buds are therefore endogenous in origin, as are the roots which very occasionally develop from these mounds. This contrasts with the origin of the shoot buds which are exogenous in *Chamaenerion*.

These findings are in agreement with those of previous investigators who have shown that, though occasionally endogenous, shoot buds of vascular plants are exogenous whereas root buds are endogenous[6-8], and the question arises as to the nature of the factors involved in determining whether a particular meristem becomes that of a root or a shoot. The results of some preliminary experiments indicate that auxins and wound hormones are involved in determining the future development of a meristem in the root cuttings of *Chamaenerion*, and further studies are being made along these lines.

I wish to express my gratitude to Prof. C. W. Wardlaw and Dr. A. Allsopp for their guidance and encouragement throughout this investigation, and to Mr. Ernest Ashby for the photographic illustrations.

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[1] Whittrock, V. B., and Walming, E., *Bot. Centralbl.*, **17**, 227, 258 (1884).
[2] Beijerinck, M. W., *Verh., K. Akad. Wetensch., Amsterdam*, 25 (1886).
[3] Priestley, J. H., and Swingle, C. F., Tech. Bull. U.S. Dept. Agric., 151 (1929).
[4] Holm, Theo., *Ann. Bot.*, **39**, 867 (1925).
[5] Moss, E. H., *Amer. J. Bot.*, **23**, 114 (1936).
[6] Lindner, R. C., *Bot. Gaz.*, **100**, 500 (1938).
[7] Naylor, B., *Bull. Torrey Bot. Club*, **68**, 351 (1941).
[8] Wardlaw, C. W., *Nature*, **171**, 88 (1953).

## Chromosome Numbers in British *Salicornia*

COUNTS so far obtained of the chromosomes of *Salicornia* species indicate the basic number $x = 9$. British material examined from localities on the estuary of the River Medway has yielded the following counts: *Salicornia perennis* Mill. var. *radicans* Moss and Salisbury in "Camb. Brit. Fl.",[1] $2n = 18$; *Salicornia ramosissima* Woods, form agreeing closely with the habit illustration in "Camb. Brit. Fl.", $2n = 18$; dwarf red form, $2n = 18$; *Salicornia stricta* Dum. sec. Moss, form agreeing closely with the illustration in "Further Illustrations of British Plants"[2] of *S. europaea* L., $2n = 36$; *Salicornia dolichostachya* Moss, erect form with long tapering fertile branches; upper nodes each bearing four branches, $2n = 36$; *Salicornia disarticulata* Moss, $2n = 16$ (?).

These counts are original, the tetraploid number of $2n = 36$ agreeing with a similar count obtained by Ludwig[3] for *S. europaea* L. (*S. stricta* Dum. sec. Moss) from the north coast of Europe. A count for the same species from the Wetterau district is given in the same paper as $2n = 18$.

Illustrations of habit specimens corresponding with these counts will appear elsewhere.

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[1] Moss, C. E., "Camb. Brit. Fl.", 11 (1914).
[2] Butcher, R. W., and Strudwick, F. E., "Further Illustrations of British Plants" (1930).
[3] Ludwig, E., *Natur und Volk.*, 80 (1950).

## Action of Peptone on Mast Cells of the Dog

ALTERATIONS of mast cells in the liver of dogs submitted to peptone shock were described by Wilander[1]; Jaques and Waters[2] have confirmed Wilander's results and found similar changes of the mast cells in anaphylactic shock. These alterations have been related by these authors to heparin liberation.

Riley and West[3] and Riley[4] observed a striking correlation between mast cells content of a tissue and its concentration of histamine. In addition, Riley[5] and we[6] verified disruption of mast cells in conditions in which histamine liberation occurs. These papers suggest that mast cells might be a source of histamine in animal tissue.

Recently, Lecomte and Baeckeland[7] could not duplicate Wilander's findings, observing no changes in dog liver mast cells after peptone shock. Our recent experiments support Wilander's results.

The effect of peptone on the mast cells was studied in ten dogs injected intravenously with 0·5 gm. per kgm. of peptone, in which blood pressure and clotting time were determined. Liver biopsies were made before and after the peptone shock. Experiments performed in order to obtain an adequate technique for the preservation of dog mast cells showed that aqueous fixatives and paraffin embedding must be avoided. Good results were obtained only with a 4 per cent solution of lead sub-acetate in 50 per cent alcohol, and this was used throughout. Frozen

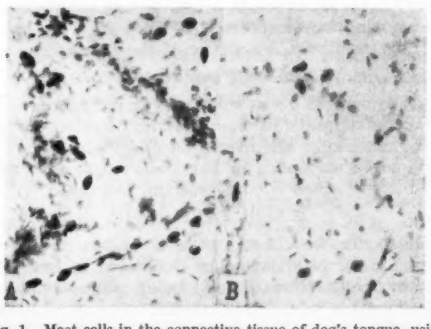


Fig. 1. Mast cells in the connective tissue of dog's tongue, using Ehrlich's thionin stain (× 300): (*A*) from control animal; (*B*) from dog after peptone shock. Note degranulation and reduction of metachromasia of remaining granules

sections, 50 μ thick, stained by Ehrlich's thionin, were studied. In these conditions, not only Wilander's observations concerning the effect of peptone shock on liver mast cells could be confirmed, but it was also observed that mast cells of other organs (tongue, spleen, mesentery, lung, etc.) presented identical changes. In the tongue, an organ particularly rich in mast cells, these changes are easily observed (Fig. 1). Peptone shock induces a significant decrease in the number of mast cells and promotes a degranulation and reduction of metachromasia of the remaining granules. These alterations seem to depend on the local concentration of peptone, since we have observed that when the peptone solution is injected directly into the lingual artery the mast cells of this organ present exceptionally intense changes. This fact, and our observations that mast cells of other organs also present alterations, suggest that in the dog, heparin and histamine might originate from other organs besides the liver. A detailed account of these results will be published.

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[1] Wilander, O., *Skand. Arch. Physiol.*, Suppl. 15 (1939).
[2] Jaques, L. B., and Waters, E. T., *J. Physiol.*, **99**, 454 (1941).
[3] Riley, J. F., and West, G. B., *J. Physiol.*, **117**, 72*P* (1952).
[4] Riley, J. F., *Science*, **118**, 332 (1953).
[5] Riley, J. F., *Proc. Soc. Exp. Med.*, Dundee Meeting, Feb. 9, 1952.
[6] Mota, I., Beraldo, W. T., and Junqueira, L. C. U., *Proc. Soc. Exp. Biol. Med.*, **83**, 455 (1953).
[7] Lecomte, J., and Baeckeland, E., *Acta Hæmatolog.*, **10**, 165 (1953).

## Myokinase as a Relaxing Factor in Muscle

Lorand[1] has recently shown that relaxation of muscle-fibre models will occur when 10 m*M* creatine phosphate, 5 m*M* adenosine triphosphate and an enzyme preparation of muscle are added to them. The enzyme (adenosine triphosphate–creatine transphosphorylase) is probably identical with Lohmann's enzyme, creatine phosphokinase[2]. Relaxation occurs only at low *p*H (6·2 or below), whereas the fibres shorten or develop tension at higher *p*H values. Magnesium ions (1 to 2 m*M*) are necessary for the relaxation which is inhibited by calcium ions. Lorand suggests that the effect is due to resynthesis of adenosine triphosphate, as fast as it is broken down by the fibres, by virtue of the reaction :

$$ADP + CP \rightleftharpoons ATP + C.$$

This is known to go to the right at *p*H values below 6·5[3]. He suggests further that any system capable of resynthesizing adenosine triphosphate would act in the same way and, in particular, that myokinase would do so, since it catalyses the reaction :

$$2\ ADP \rightleftharpoons ATP + AMP.$$

I have, in fact, been able to show, in a paper submitted for publication in December of last year[4], that myokinase does indeed bring about relaxation of muscle-fibre models, and that it is indistinguishable in its effect from the relaxing factor of Marsh[5]. For full-activity magnesium ions (4 m*M*), an ionic strength between 0·10 and 0·20, and a *p*H in the range 6·8–7·2 are optimal. The effect is entirely abolished by 0·2 m*M* calcium chloride. Over a wide range the activity of the preparations as myokinase and their activity as a relaxing factor go hand in hand. The evidence suggests, however, that in its role as relaxing factor myokinase is acting in a way which cannot be explained simply in terms of its ability to resynthesize adenosine triphosphate, and that it probably takes part in a more complex reaction, when actomyosin and the adenosine nucleotides are present.

Thus, the effect of the original factor of Marsh can be explained in terms of its myokinase activity ; but it is quite out of the question to explain it in terms of creatine phosphokinase, since (*a*) the conditions of preparation and use of the factor preclude the possibility of the presence of creatine phosphate in the system ; and (*b*) the effect is optimal in the normal physiological *p*H range, 6·8–7·2, and is diminished in the range 6·0–6·5.

The work described in this paper was carried out as part of the programme of the Food Investigation Organization of the Department of Scientific and Industrial Research.

J. R. Bendall.
Low Temperature Station for
Research in Biochemistry and Biophysics,
University of Cambridge, and
Department of Scientific and Industrial Research.
Feb. 8.

[1] Lorand, L., *Nature*, **172**, 1181 (1953).
[2] Dixon, M., and Needham, D. M., *Nature*, **158**, 432 (1946).
[3] Lohmann, H., *Biochem. Z.*, **288**, 336 (1936).
[4] Bendall, J. R., *Proc. Roy. Soc.*, B (in course of publication).
[5] Marsh, B. B., *Biochim. Biophys. Acta*, **9**, 247 (1952). Hasselbach, W., and Weber, H. H., *Biochim. Biophys. Acta*, **11**, 160 (1953). Bendall, J. R., *J. Physiol.*, **121**, 232 (1953).

## Coenzyme of Kidney Phosphatase

In previous communications[1] we advanced a hypothesis supporting the nucleotide nature of kidney phosphatase. Kutscher and Schreier[2] also consider phosphatases as metal proteins, and they attribute the loss in activity which they display on dialysis not only to the elimination of magnesium, but also to the separation of another substance which Kutscher and Sieg[3] designate as choline pyrophosphate. In their turn, Akamatsu and Kobayashi[4] regard histidine as a coenzyme. Recently, however, investigating intestinal phosphatase preparations purified by paper electrophoresis, Roche considers[5], in view of the results obtained in his analyses, that the hypotheses advanced on the nature of cophosphatase (nucleotide, choline pyrophosphate or histidine) are scarcely probable.

So far as we are concerned, the results obtained in the course of recent experiments still support our interpretation. As a matter of fact, the phosphatase by extraction with trichloroacetic acid, in order to separate the protein portion, and subsequent hydrolysis with baryta, gave solutions which were chromatographed on Whatman No. 1 paper with the object of characterizing the nucleotide. We employed the 2 *N* HCl–isopropanol mixture which Wyatt recommends[6] and developed the chromatogram in the presence of ultra-violet light, employing a quartz lamp fitted with a Corning 9863 filter (240–400 mμ). A spot, thus obtained. Once that portion of paper which

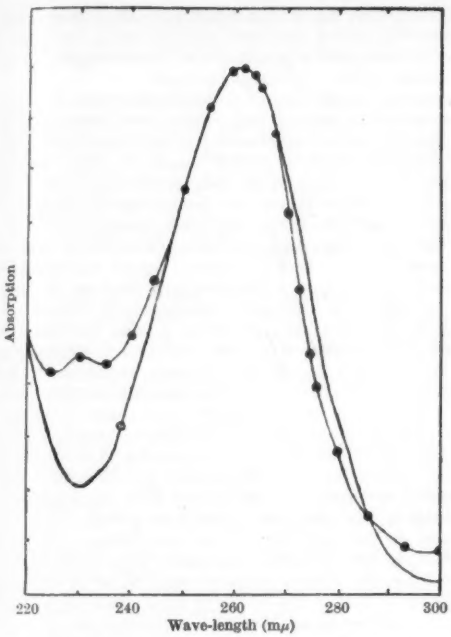


Fig. 1. Absorption curves: ●—●—, phosphatase; ○—○—, uridylic acid (Ploeser and Loring, *J. Biol. Chem.*, **178**, 431; 1949)

corresponds to the phosphatase spot in the chromatogram had been separated we obtained, after eluting with 0·01 *N* HCl, the spectrum shown in Fig. 1 (with a maximum of 261 mμ), falling in with that of uridylic acid, which appears superimposed.

It is evident that, despite this result, the lack of a purity guarantee in the phosphatase preparation we employed is a factor of a weight sufficient to prevent us from affirming that uridylic acid is a component of the former. In order to ascertain, in so far as feasible, its participation in the structure of phosphatase, we proceeded to inoculate rats and rabbits with a precursor of uridylic acid, orotic-2-$^{14}$C acid[7], with the object of investigating the possible presence of $^{14}$C in the kidney phosphatase of the inoculated animals as well as its relationship to enzymatic activity. The results obtained are reproduced in the accompanying table.

The results reveal that a variation in the enzymatic activity of the preparation (percentage P) is attended by a variation in counts/min. practically

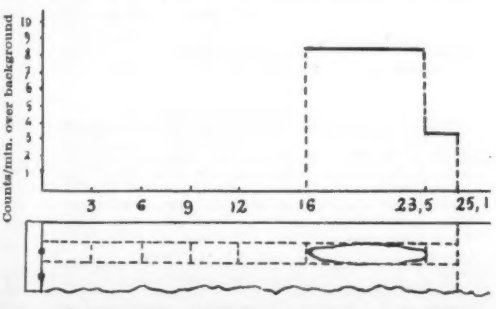


Fig. 2. Counting of chromatogram. Horizontal axis of histogram is in cm.

| No. of experiment | Phosphatase preparation | Radioactivity | | Enzymatic activity | |
|---|---|---|---|---|---|
| | | c./m. | % Δ | % P hydrolysed | % Δ |
| 1 | *a* | 1,370 | | 19·8 | |
| | $a_1$ | 1,900 | 36 | 27·3 | 35 |
| | *b* | inestimable | | 0·84 | |
| 2 | *a* | 1,480 | | 24·8 | |
| | $a_1$ | 2,060 | 39 | 33·8 | 36 |
| | *b* | 420 | −80 | 4·9 | −85 |

*a*, According to Albers[8].
$a_1$, According to Albers[8] purified by reprecipitations with acetone.
*b*, Precipitated by alcohol from the enzymatic solution after separating *a*.

checking in percentage. This permits us to attribute both effects to the same substance.

Once the radioactive phosphatase has been hydrolysed under conditions identical with those in previous experiments and the chromatogram developed, the portion of paper corresponding to the uridylic acid stain was cut away while the rest of the chromatogram was cut into several pieces. All these were eluted with 0·01 *N* HCl before evaporating to dryness and counting in the Geiger–Müller counter. As Fig. 2 shows, the portion corresponding to uridylic acid displayed a marked radioactivity, and only that part contiguous to it was radioactive but in a much lesser scale. The protein fraction separated by trichloroacetic acid displayed no radioactive activity at all. All the carbon-14 in phosphatase is therefore present in uridylic acid. As, on the other hand, the table permits us to refer enzymatic activity to this same substance, it seems probable that uridylic acid is a component of kidney cophosphatase.

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Nov. 30.

[1] Lora-Tamayo, M., and Municio, A. M., *Nature*, **168**, 248 (1951); *Enzymologia*, **35**, 377 (1953). Lora-Tamayo, M., and Baluja, G., *Bull. Soc. Chim. Biol.*, **35**, 231 (1953).
[2] Kutscher, W., and Schreier, *Naturwiss.*, **35**, 255 (1948).
[3] Kutscher, W., and Sieg, H., *Naturwiss.*, **37**, 451 (1950).
[4] Akamatsu, S., and Kobayashi, K., *Enzymologia*, **15**, 154 (1952).
[5] Roche, J., and Bouchilloux, S., *Bull. Soc. Chim. Biol.*, **35**, 567 (1953).
[6] Wyatt, G. R., *Biochem. J.*, **48**, 534 (1951).
[7] Lora-Tamayo, M., Gamboa, N. M., and Alvarez, Eldiberto F., *Anal Fis. y Quim.*, **48**, B, 889 (1952).
[8] Albers, H., and Albers, E., *Z. physiol. Chem.*, **232**, 189 (1935).

## X-Ray Analysis of the Structure of Peripheral Nerve Myelin

The low-angle diffraction pattern of fresh sciatic nerve of frog takes a relatively simple form, showing only six equatorial reflexions, five of which can be accounted for as successive orders of diffraction from a radially oriented fundamental structural unit measuring 171 A.[1,2]. These five reflexions display striking variations in intensities as indicated in Fig. 1*a*, and from this intensity data a Patterson distribution (variation of $P = F^2_{(001)} \cos 2\pi lz$) along a line in the radial direction in the sheath has been calculated (Fig. 1*a*).

In earlier experiments on the modification of nerve myelin[3–5], it was observed that a relatively slight drying of the nerve specimen produced a marked increase in the intensity of the third-order diffraction and a decrease in the intensities of the higher orders.

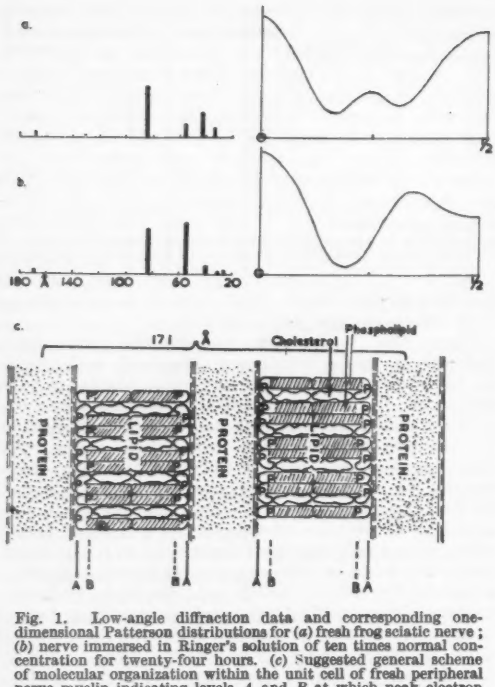


Fig. 1. Low-angle diffraction data and corresponding one-dimensional Patterson distributions for (*a*) fresh frog sciatic nerve; (*b*) nerve immersed in Ringer's solution of ten times normal concentration for twenty-four hours. (*c*) Suggested general scheme of molecular organization within the unit cell of fresh peripheral nerve myelin indicating levels *A* and *B* at which peak electron densities might be expected. The approximate positions of phosphate groups in phospholipid molecules are marked with the letter *P*

These changes were accompanied by a small reduction (*c.* 5–6 A.) in the fundamental spacing, and were reversible. A similar effect (Fig. 1*b*) was obtained under more readily controllable conditions by immersing the nerve in Ringer's solution of greater than normal concentration[4].

The net effect on the Patterson diagrams of this modification is to replace the interaction at a quarter by a much stronger interaction at one-third of the unit cell dimension.

Other modifications[3–5] of the nerve myelin were found to lead eventually to the disappearance of the odd orders of diffraction. Such modifications were irreversible.

In spite of the apparent chemical complexity of myelin, it is possible that the striking diffraction effects observed have a relatively simple explanation in terms of the general arrangement of molecules within the unit cell and the specific placing of a few atoms or groups of atoms of outstanding diffracting power. In previous considerations of the structure of myelin[2,7,8], molecular arrangements based on an alternation of lipid layers and protein layers have been suggested which would account for the tendency towards 'halving' in the 171-A. dimension of the unit cell. The observations on the changes in pattern accompanying slight dehydration seem to be explained most readily on the general assumption that two sets of closely spaced groups of high diffracting power are responsible for the interactions, one set being separated by a quarter in the fresh myelin and the second set by a distance just greater than one-third. The shrinkage of the fundamental structural unit in the initial reversible stage of drying may be sufficient to reduce the separation of the first set of groups so that they can no longer reinforce the fourth-order diffraction, and at the same time to bring the second set of groups into a position for reinforcing the third and sixth orders.

A recent suggestion of a detailed spatial arrangement of phospholipid and cholesterol molecules in the lipid layers of myelin[2,9,10] immediately indicates two sets of levels at which peaks in the electron density distribution in the radial direction might be expected. These peaks are associated in part with the phosphate groups of the phospholipids which, in a lipoprotein structure consisting mainly of carbon, nitrogen, oxygen and hydrogen, might be expected to provide centres of outstanding electron density. Fig. 1*c* shows a schematic arrangement of components in the unit cell of nerve myelin in terms of which it is possible to give a qualitative explanation of the intensities of the various reflexions. For simplicity, the positions of the electron density peaks have been made identical in the two parts of the unit cell, and therefore different 'scattering factors' must be given to these levels to account for the intensities of the odd orders of diffraction. The longest phospholipid molecules are associated with the cholesterol in such a way that the phosphate group (*P*) of the former is brought into close association with the protein at the interface *A*, which may also contain metallic ions. This interface would thus be expected to provide one of the levels of high electron density, and is suggested to occur at or near 0, $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$ in the unit cell of slightly dehydrated myelin. With the type of spatial arrangement of phospholipid and cholesterol molecules shown in Fig. 1*c* a second level of high electron density might be expected to occur in the lipid layer at a distance of about 4–6 A. from the interface, where the terminal groups of the curled phospholipid molecules come into association with the cholesterol, and in the case of phosphatidyl serines possibly also with metallic ions. The phosphate groups of any fully extended phospholipid molecules would also be expected to occur at this level, *B*, which is suggested to be at 0, $\frac{1}{4}$, $\frac{1}{2}$, $\frac{3}{4}$ in the unit cell of fresh myelin.

Rough Fourier calculations have indicated the possibility of obtaining the right sequence of intensities for the various orders of diffraction in terms of these sets of electron density peaks; but two main factors hinder the detailed quantitative correlation. The molecular picture is not yet sufficiently detailed to permit the reliable prediction of the relative heights of the suggested electron density peaks, and the correction factors which must be applied to the measured intensities from this type of liquid crystalline system are not yet known.

J. B. Finean

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University of Birmingham.
Dec. 4.

[1] Schmitt, F. O., *Multiple Sclerosis and the Demyelinating Diseases*, 28, 247 (1950).
[2] Finean, J. B., *Exp. Cell. Res.*, 5, 202 (1953).
[3] Elkes, J., and Finean, J. B., Farad. Soc. Disc., No. 6 (Lipoproteins), 134 (1949).
[4] Elkes, J., and Finean, J. B., *Exp. Cell Res.*, 4, 69 (1953).
[5] Elkes, J., and Finean, J. B., *Exp. Cell Res.*, 4, 82 (1953).
[6] Unpublished results.
[7] Schmidt, W. J., *Z. wiss. Mik.*, 54, 159 (1937).
[8] Schmitt, F. O., Bear, R. S., and Palmer, K. J., *J. Cell. Comp. Physiol.*, 18, 21 (1941).
[9] Finean, J. B., Internat. Colloquium on Biochemical Problems of Lipids, Brussels, 1953 (in the press).
[10] Finean, J. B., *Experientia*, 9, 17 (1953).

# FORTHCOMING EVENTS

*(Meetings marked with an asterisk • are open to the public)*

## Monday, March 22

BONE AND TOOTH SOCIETY (at the Institute of Orthopaedics, 234 Great Portland Street, London, W.1), at 5 p.m.—Symposium on "Hereditary Skeletal Disease". Prof. L. S. Penrose: "Genetics and Bone Disease"; Dr. H. Grüneberg: "Genetics and Bone Disease in Animals"; Dr. H. Harris: "Genetics of Rickets and Osteomalacia".

ROYAL GEOGRAPHICAL SOCIETY (at 1 Kensington Gore, London, S.W.7), at 5 p.m.—Mr. J. F. M. Middleton: "Oxford University Expedition to Uganda".

ROYAL INSTITUTE OF CHEMISTRY, LONDON SECTION (at Dartford Technical College, Lowfield Street, Dartford, Kent), at 7.30 p.m.—Dr. J. M. Fletcher: "Chemical Problems Associated with Nuclear Reactors".

## Monday, March 22—Friday, March 26

CIBA FOUNDATION FOR THE PROMOTION OF INTERNATIONAL CO-OPERATION IN MEDICAL AND CHEMICAL RESEARCH (at 41 Portland Place, London, W.1).—Symposium on "The Chemistry and Biology of Pteridines".

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2)—Bicentenary Celebrations.

## Tuesday, March 23

INSTITUTE OF FUEL (at the Institution of Mechanical Engineers, 1 Birdcage Walk, Westminster, London, S.W.1), at 5.30 p.m.—Dr. H. Heywood: "Solar Energy for Water-and-Space-Heating".•

UNIVERSITY OF LONDON (in the Anatomy Theatre—Communication Research Centre, University College, Gower Street, London, W.C.1), at 5.30 p.m.—Sir Geoffrey Vickers: "Communication in Economic Systems".•

INSTITUTION OF ELECTRICAL ENGINEERS, EDUCATION DISCUSSION CIRCLE (at Savoy Place, London, W.C.2), at 6 p.m.—Mr. F. A. Meier: "An Experimental and Theoretical Approach to the Teaching of Electromagnetism using the Rationalized M.K.S. System of Units".

SOUTH PLACE ETHICAL SOCIETY (at Conway Hall, Red Lion Square, London, W.C.1), at 7.30 p.m.—Dr. J. Bronowski: "The Fulfilment of Man" (Conway Memorial Lecture).

## Wednesday, March 24

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 2.30 p.m.—Sir Ben Lockspeiser, F.R.S.: "Manufactures, 1754–1954", (Special Bicentenary Lecture.)

PHYSICAL SOCIETY, COLOUR GROUP (at the Institute of Ophthalmology, Judd Street, London, W.C.1), at 3.15 p.m.—Fourteenth Annual General Meeting. 3.30 p.m.—Miss P. W. Trezona: "Additivity of Colour Equations"; Dr. G. S. Brindley: "The Number of Kinds of Human Retinal Receptors and the Spatial and Temporal Summation and Resolution allowed by their Pathways".

ROYAL STATISTICAL SOCIETY (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 5.15 p.m.—Mr. Colin Clark: "World Supply and Requirements of Farm Products".

EUGENICS SOCIETY (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Dr. J. M. Tanner: "Physique and Choice of Career".•

SOCIETY OF CHEMICAL INDUSTRY, FOOD GROUP—NUTRITION PANEL (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 6.15 p.m.—Annual General Meeting.

ROYAL INSTITUTE OF CHEMISTRY (joint meeting with the LONDON SECTION of the SOCIETY OF CHEMICAL INDUSTRY, at the Institute of Metals, Grosvenor Gardens, London, S.W.1), at 6.30 p.m.—Prof. A. R. J. P. Ubbelohde, F.R.S.: "Some Recent Advances in Physical Chemistry".

WOOL EDUCATION SOCIETY (at the Royal Institution, 21 Albemarle Street, London, W.1), at 7 p.m.—Sir John Lienhop: "Growing Wool in Victoria".

CHADWICK PUBLIC LECTURE (in collaboration with the Leeds City Council, in the Museum Lecture Theatre, Park Row, Leeds 1), at 7.30 p.m.—Prof. S. E. Finer: "Edwin Chadwick and the Conquest of Disease 1843–1953".•

## Wednesday, March 24—Friday, March 26

SOCIETY OF CHEMICAL INDUSTRY, PLASTICS AND POLYMER GROUP (at the Institution of Electrical Engineers, Savoy Place, London, W.C.2)—Symposium on "The Chemistry and Physics of Synthetic Fibres".

## Thursday, March 25

ROYAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.30 p.m.—Prof. G. R. Goldsbrough, F.R.S.: "Wind-effects on the Motion of the Sea in an Infinite Channel and in a Rectangular Gulf"; Mr. N. E. Rider: "Eddy Diffusion of Momentum, Water Vapour and Heat Near the Ground".

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, London, W.C.2), at 5.30 p.m.—Mr. F. L. Lawton: "The Kemano Hydro-Electric Development and Associated Kitimat Aluminium-Reduction Works".

TELEVISION SOCIETY (at the Cinematograph Exhibitors' Association, 164 Shaftesbury Avenue, London, W.C.2), at 7 p.m.—Mr. R. J. Boddy and Mr. C. D. Gardner: "An Industrial Television Channel".

CHEMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 7.30 p.m.—Prof. H. J. Emeléus, F.R.S.: "Organometallic Compounds Containing Fluorocarbon Radicals" (Liversidge Lecture).

## Thursday, March 25—Friday, March 26

NATIONAL ASSOCIATION FOR MENTAL HEALTH (at Friends' House, Euston Road, London, N.W.1), at 10 a.m. daily—Annual Conference—"Strain and Stress in Modern Living: Special Opportunities and Responsibilities of Public Authorities".

## Friday, March 26

INSTITUTION OF MECHANICAL ENGINEERS (at 1 Birdcage Walk, Westminster, London, S.W.1), at 10.30 a.m.—Conference on "Hydraulic Mechanisms".

ROYAL ASTRONOMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 4.15 p.m.—Geophysical Discussion. Speakers: Dr. J. M. Bruckshaw, Dr. A. H. Cook, F.R.S., Sir Harold Jeffreys, F.R.S., and Dr. S. K. Runcorn. Chairman: Dr. R. Stoneley, F.R.S.

PHYSICAL SOCIETY (at the Science Museum, Exhibition Road, London, S.W.7), at 5 p.m.—Sir Geoffrey Taylor, F.R.S.: "Diffusion and Mass Transport in Tubes"• (38th Guthrie Lecture).

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 9 p.m.—Dr. F. A. Paneth, F.R.S.: "The Chemical Exploration of the Stratosphere".

## Saturday, March 27

BRITISH SOCIOLOGICAL ASSOCIATION (in the Herringham Hall, Bedford College, Regent's Park, London, N.W.1), at 4.30 p.m.—Prof. W. J. H. Sprott: "Theory and Practice".

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# APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER (with good university degree or equivalent, with considerable teaching and industrial or research experience) IN AIRCRAFT STRUCTURES, to teach to Final B.Sc. and H.N.C. standard—The Principal, Royal Aircraft Establishment Technical College, Farnborough, Hants (March 26).

LECTURER IN PHYSICS—The Secretary, Birkbeck College, Malet Street, London, W.C.1 (March 26).

METALLURGIST (with an honours degree in metallurgy and some experience in metallurgical research, and preferably with experience in the use of X-ray equipment) at the B.I.S.R.A. Laboratories in Swansea—The Personnel Officer, British Iron and Steel Research Association, 11 Park Lane, London, W.1 (March 26).

COAL CHEMIST (Scientist Grade I) (with first- or second-class honours degree in chemistry, fuel technology or related subjects, and substantial experience of research in the above field) to lead research on the carbonizing properties of coal used for smokeless fuel manufacture, Ref. TT/745; SCIENTIST (with good honours degree or equivalent, and preferably with general experience in coal chemistry and spectroscopic techniques), for work in the Chemistry Department in connexion with infra-red and ultra-violet spectroscopy, Ref. TT/746—The National Coal Board, Central Research Establishment, Stoke Orchard, near Cheltenham, Glos, quoting appropriate Ref. No. (March 27).

SCIENTIST in the Scientific Department of the London Headquarters of the National Coal Board, for work mainly in the hydraulic and mechanical fields, and will include the planning of large-scale experiments and the co-ordination of research data in forms suitable for use by engineers—The National Coal Board, Establishments (Personnel), Hobart House, Grosvenor Place, London, S.W.1, quoting TT/747 (March 27).

SENIOR LECTURER and a LECTURER IN PHYSICS at the University of Natal, Pietermaritzburg, and a LECTURER IN PHYSICS at the University of Natal, Durban—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (South Africa, April 7).

ASSISTANT COAL SURVEY OFFICER (with a good honours degree, or equivalent, in chemistry or fuel technology, and preferably with experience in industry, laboratory control, and the critical assembly of scientific data) at the Coal Survey Laboratory, Sheffield—The National Coal Board, Establishments (Personnel), Hobart House, Grosvenor Place, London, S.W.1, quoting TT/754 (April 10).

MATHEMATICIANS, Scientific Officer, Experimental Officer and Assistant Experimental Officer grades, in Ministry of Supply Research and Development Establishments, mainly in Southern England, for work including research into aerodynamics and aircraft structures, high speed electronic computers, radio and radar, including aerial design and radiation problems, engineering problems, and trials work requiring good practical outlook—The Ministry of Labour and National Service, Technical and Scientific Register (K), 26 King Street, London, S.W.1, quoting A2/54/A (April 14).

SOIL PHYSICIST (graduate who has received training in a recognized Soil Physics Laboratory, or with postgraduate experience in soil physics work, and preferably with experience in soil problems connected with irrigation) at the Sabi Valley Experimental Station, Department of Agriculture, Southern Rhodesia—The Secretary, Rhodesia House, 429 Strand, London, W.C.2 (April 15).

ANALYST IN THE DEPARTMENT OF AGRICULTURE—The Registrar, The University, Leeds 2 (April 19).

READER IN VETERINARY BIOCHEMISTRY at the Royal Veterinary College—The Academic Registrar, University of London, Senate House, London, W.C.1 (April 29).

CHAIR OF CHEMISTRY in University College, Dundee—The Secretary, University of St. Andrews, College Gate, St. Andrews (April 30).

LECTURER IN BIOCHEMISTRY—The Secretary, Queen's University, Belfast (April 30).

LECTURER (with degree in metallurgy, engineering or related science) IN INDUSTRIAL METALLURGY—The Registrar, The University, Edgbaston, Birmingham 15 (April 30).

PEDOLOGIST or ASSISTANT PEDOLOGIST (with a good degree in science or agriculture or equivalent, and ability to express ideas in written work) at the Soil Bureau, Department of Scientific and Industrial Research, New Zealand, for soil surveys in New Zealand, and possibly for short-term secondment in the Pacific Islands—The High Commissioner for New Zealand, 415 Strand, London, W.C.2, quoting 3/64/142 (April 30).

RESEARCH OFFICER (graduate in physics, mechanical engineering, physical chemistry, or chemical engineering, and preferably with some experience of research in the preservation, processing and transport of food, preferably fish) AT THE FISHING INDUSTRY RESEARCH INSTITUTE, Cape Town, South Africa—The Secretary, P.O. Box 1233, Cape Town, South Africa (April 30).

SENIOR LECTURER IN ADULT EDUCATION at the University of New England, Armidale, New South Wales, Australia, to organize and administer tutorial classes, discussion groups, and other general adult education activities in northern New South Wales as may be required by the Council of the University—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (Armidale, April 30).

SENIOR LECTURER or LECTURER (university graduate, or chartered mechanical engineer, and with some years of industrial experience in a design office) IN MACHINE DESIGN, in the Department of Mechanical Engineering, University of Western Australia—The Secretary, Association of Universities of the British Commonwealth, 5 Gordon Square, London, W.C.1 (Australia, April 30).

ENGLISH ELECTRIC RESEARCH FELLOW IN AERONAUTICS, for post-graduate research into problems of vibration or stability and control of aircraft—The Warden, College of Aeronautics, Cranfield, Bletchley, Bucks (May 1).

CHAIR OF CHEMICAL PATHOLOGY in St. Mary's Hospital Medical School—The Academic Registrar, University of London, Senate House, London, W.C.1 (May 3).

CHAIR OF PHYSICAL CHEMISTRY tenable at the Imperial College of Science and Technology—The Academic Registrar, University of London, Senate House, London, W.C.1 (May 5).

CHAIR OF PHYSIOLOGY tenable at Queen Elizabeth College—The Academic Registrar, University of London, Senate House, London, W.C.1 (May 6).

ASSISTANT BOTANIST (preferably with experience in microscopy, and with mathematical ability) IN THE POMOLOGY SECTION for work on plant anatomy—The Secretary, East Malling Research Station, near Maidstone, Kent (May 17).

PERRING SCHOLAR (preferably honours graduate, or final year undergraduate in engineering, mathematics or physics) IN AERONAUTICS—The Warden, College of Aeronautics, Cranfield, Bletchley, Bucks (June 1).

DEMONSTRATOR IN ORGANIC CHEMISTRY and DEMONSTRATORS IN INORGANIC CHEMISTRY—The Registrar, The University, Nottingham.

INSTRUCTOR AND ASSISTANT PROFESSOR IN THE DEPARTMENT OF BACTERIOLOGY at the Hebrew University of Jerusalem—Prof. Samson Wright, Middlesex Hospital, London, W.1.

LECTURER (with a university degree in agriculture, preferably with knowledge of tropical agriculture, and some teaching experience) IN AGRICULTURE, at the College of Agriculture, Mauritius—The Director of Recruitment, Colonial Office, Great Smith Street, London, S.W.1, quoting CDE.63/52/06.

MASTER (with first-class honours degree, preferably Oxford or Cambridge) TO TEACH BIOLOGY up to University Scholarship standard —The Headmaster, Haberdashers' Aske's Hampstead School, Westbere Road, London, N.W.2.

PHYSICIST (with a degree in physics, and capable of applying experimental techniques to the solution of fluid problems in the iron and steel industry) IN THE FLUID DYNAMICS SECTION of the Physics Department in London—The Personnel Officer, British Iron and Steel Research Association, 11 Park Lane, London, W.1.

RESEARCH SCIENTIST (with B.Sc., preferably in physics) for research on domestic heating—The British Coal Utilization Research Association, Randalls Road, Leatherhead, Surrey, quoting A.3.

SCIENTIFIC OFFICER (with an honours degree in science, preferably physics, with postgraduate course, or equivalent experience in meteorology) AT THE ROYAL OBSERVATORY, Hong Kong, for forecasting, general meteorology, research, etc.—The Director of Recruitment, Colonial Office, Great Smith Street, London, S.W.1, quoting CDE. 57/51/03.

SCIENTIFIC OFFICERS (with first- or second-class honours degree in chemistry or equivalent) and EXPERIMENTAL OFFICERS (with at least H.S.C. (science) or equivalent) to undertake research involving the study of various physical and electrical properties of solid inorganic chemical materials, and their behaviour in ceramic applications—The Administrative Officer, Recruitment, Atomic Weapons Research Establishment, Aldermaston, Berks, quoting 40/W.G.E.

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# REPORTS and other PUBLICATIONS

*(not included in the monthly Books Supplement)*

## Great Britain and Ireland

General Post Office. Second Report of the Television Advisory Committee, 1952. Pp. 26. (London: H.M. Stationery Office, 1954.) 1s. net. [191

Ministry of Agriculture and Fisheries. Fishery Investigations. Series 1, Vol. 5, No. 7. Part 1: The Scales of Roach; Part 2: Age and Growth of the Trout (*Salmo trutta*), Grayling (*Thymallus thymallus*), Perch (*Perca fluviatilis*), and Roach (*Rutilus rutilus*), of Llyn Tegid (Bala) and the Roach of the River Birket. By Dr. J. W. Jones. Pp. 18. (London: H.M. Stationery Office, 1953.) 2s. net. [201

General Register Office. Census 1951, England and Wales. County Report: Middlesex. Pp. xlvi+70. (London: H.M. Stationery Office, 1954.) 20s. net. [201

## Other Countries

Report on Federal Forest Administration in the Federation of Malaya, for the year 1952. By J. P. Edwards. Pp. 70+4 plates. (Kuala Lumpur: Government Printer, 1953.) 2 Malayan dollars; 4s. 8d. [151

Federation of Malaya. Annual Report of the Department of Agriculture for the year 1952. By O. J. Voelcker. Pp. viii+66. (Kuala Lumpur: Government Printer, 1953.) 2 Malayan dollars; 4s. 8d. [151

California Institute of Technology. Annual Report 1952–1953. Comprising the Reports of the President, the Secretary, the Comptroller, and Other Administrative Officers. Pp. v+142. (Pasadena, Calif.: California Institute of Technology, 1953.) [151

Commonwealth of Australia. Department of Supply, Research and Development Branch. Annual Report of the Defence Standards Laboratories for the year ended 30th June, 1953. Pp. 56. (Maribynong, Vic., Alexandria, N.S.W., Finsbury, S.A.: Department of Supply, Research and Development Branch, 1953.) [151

Commonwealth of Australia. Commonwealth Scientific and Industrial Research Organization. Fifth Annual Report, for the year ending 30th June, 1953. Pp. vi+290. (East Melbourne: Commonwealth Scientific and Industrial Research Organization, 1953.) [151

Labo 53. (Handbook of Laboratory Apparatus, Scientific and Technical Instruments.) Pp. ii+464+viii. (Paris: O.P.F., 61 Rue de Malte, 1953.) [151

Publications of the Yerkes Observatory. Vol. 8, Part 6: Measurements of Double Stars. By G. Van Biesbroeck. Pp. ii+224. (Chicago: University of Chicago Press; London: Cambridge University Press, 1954.) 10 dollars. [151

Sveriges Geologiska Undersökning. Ser.Aa. No. 192: Beskrivning till Kartbladet Önsala. Av R. Sandegren och P. H. Lundegårdh. Pp. 100+1 plate. 10 kronor. Ser.Aa. No. 194: Beskrivning till Kartbladet Säter. Av S. Hjelmqvist och G. Lundqvist. Pp. 98+1 plate. 10 kronor. Ser.C. No. 518: Vissa Amnens Fordelning I Markes I Kopparbergs Län. Av O. Arrhenius. Pp. 40. 2.50 kronor. Ser.C. No. 519: Fjärås Bräcka. Av Carl-Gösta Wenner. Pp. 16+3 plates. 3 kronor. Ser.C. No. 520: Kvarts, Fältspat och Glimmer: Samt Förekomster Därav I Sverige. Av Nils Sundius. Pp. 232+2 plates. 10 kronor. Ser.C. No. 521: Lime Metasomatism and Metamorphic Differentiation in the Adak Area. By Sven Gavelin. Pp. 52. 3.50 kronor. Ser.C. No. 523: Konglomeratet På Ålingsberget I Nederluleå S:N. Av Erik Åhman och Olof H. Ödman. Pp. 20+1 plate. 1.50 kronor. Ser.C. No. 524: Geology and Ores of the Kristineberg Deposit, Vesterbotten, Sweden. By Torsten Du Rietz. Pp. 90+4 plates. 6.50 kronor. Ser.C. No. 525: Bergarterna I Delamoranernas Block-Och Grusmaterial. Av Jan Lundqvist. Pp. 48. 3.50 kronor. Ser.C. No. 526: Non-Agnostidean Trilobites of the Middle Cambrian of Sweden. III. By A. H. Westergård. Pp. 60 (8 plates). 4 kronor. Ser.C. No. 527: De Geologiska Resultaten Från Borrningarna Vid Hollviken. Del V: The Macro-Fossils of the Upper Cretaceous. By Hilmar Ödum. Pp. 38+4 plates. 3.50 kronor. (Stockholm: Kungl. Boktryckeriet. P. A. Norstedt and Söner, 1952 and 1953). [181

Sveriges Geologiska Undersökning. Ser.C. No. 528: Der Geologische Bau Des Suilteima-Salojaureg ebietes in den Nordskandinavischen Kaledoniden. Von G. Kautsky. Pp. 228+9 plates. 15 kronor. Ser.C. No. 529: Vallen-Alhamnomradet I Nederluleå S:N. Av Erik Åhman. Pp. 22+1 plate. 2 kronor. Ser.C. No. 531: Petrology of the Mondal-Styrso-Vallda Region in the Vicinity of Gothenburg. By H. Lundegårdh. Pp. 58+1 plate. 4 kronor. Ser.C. No. 532: Jordskalv I Sverige, 1941–1950. Av K. E. Sahlström. Pp. 34+1 plate. 2 kronor. Ser.Ad. No. 2: Beskrivning till Kartbladet Lund. Av Gunnar Ekström. Pp. 102+2 maps. 8 kronor. Årsberättelse för År 1950. Pp. 8. 0.50 kronor. Årsberättelse för År 1952. Pp. 10. 0.50 kronor. (Stockholm: Kungl. Boktryckeriet. P. A. Norstedt and Söner, 1952 and 1953.) [181

Survey of India. Technical Report, 1952. Part 3: Geodetic Work. Pp. x+90+22 charts. (Dehra Dun: Geodetic and Training Circle Survey of India, 1953.) 6 rupees; 9s. 6d. [181

Commonwealth Scientific and Industrial Research Organization, Australia. Soil Publication No. 2: Pedology of Part of the Upper Hunter Valley, New South Wales. By R. Brewer and B. E. Butler. Pp. 104. Soil Publication No. 3: The Soils of Part of the Southern Flinders Ranges, South Australia. By G. Blackburn and R. M. Baker. Pp. 56+2 plates. Bulletin No. 272: Standardized Plant Names: a Revised List of Standard Common Names for the More Important Australian Grasses, Other Pasture Plants, and Weeds. Pp. 132. Bulletin No. 273: The Definition and Prediction of the Optimal Harvest Time of Pea Canning Crops. By L. J. Lynch and R. S. Mitchell. Pp. 44. (Melbourne: Commonwealth Scientific and Industrial Research Organization, 1953.) [181

Smithsonian Miscellaneous Collections. Vol. 122, No. 8: Further Additions to the Birds of Panama and Colombia. By Alexander Wetmore. Pp. 12. (Publication 4142.) (Washington, D.C.: Smithsonian Institution, 1953.) [191

Bulletin of the Central Building Research Institute, Roorkee. Vol. 1, No. 3: Corrugated Concrete Shell Roofs. By Dr. Kurt Billig. Pp. 40+14 plates. (New Delhi: Council of Scientific and Industrial Research, 1953.) 1 rupee, 8 annas. [191

Göteborgs Kungl. Vetenskaps- och Vitterhets- Samhälles Handlingar. Sjätte Följden. Ser.B. Band 6, No. 9: Acidimetric Carbonate Analysis. Av Stina Gripenberg. Pp. 32. (Göteborg: Elanders Boktryckeri Aktiebolag, 1953.) [191

Annual Report of the Kodaikanal Observatory for the Year 1951. Pp. 10. 1 rupee; 1s. 6d. Annual Report of the Kodaikanal Observatory for the Year 1952. Pp. 12. 12 annas; 1s. (Delhi: Manager of Publications.) [191

Kodaikanal Observatory. Bulletin No. 132. Part 1: Summary of Prominence Observations for the First Half of 1950. Pp. 46. 7 rupees, 8 annas; 12s. 6d. Bulletin No. 133: A Note on the Observations of Sunspots Recorded at Kodaikanal from 1903 to 1950. By R. Ananthakrishnan. Pp. 12. 1 rupee, 8 annas; 2s. 3d. Bulletin No. 134. Part 1: Summary of Prominence Observations for the Second Half of 1950. Pp. 59–102. 3 rupees, 3 annas; 5s. 6d. (Delhi: Manager of Publications, 1953.) [191